Safety Evaluation Report

Related to the License Renewal of the Virgil C. Summer Nuclear Station

Docket No. 50-395

South Carolina Electric & Gas Company (SCE&G)

U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Washington, DC 20555-0001

October 2003

THIS PAGE IS INTENTIONALLY LEFT BLANK

ABSTRACT

This safety evaluation report (SER) documents the technical review of the Virgil C. Summer Nuclear Station (VCSNS), license renewal application (LRA) by the U.S. Nuclear Regulatory Commission staff. By letter dated August 6, 2002, South Carolina Electric & Gas Company (SCE&G or the applicant) submitted the LRA for VCSNS in accordance with Title 10 of the *Code of Federal Regulations,* Part 54 (10 CFR Part 54 or the Rule). SCE&G is requesting renewal of the operating license for VCSNS (License No. NPF-12) for a period of 20 years beyond the current license expiration of midnight, August 6, 2022.

The VCSNS plant is located in Fairfield County, in predominantly rural north-central South Carolina. It is situated on the shore of the Monticello Reservoir about 42 kilometers (26 miles) northwest of Columbia, the State capitol. The VCSNS unit consists of a Westinghouse pressurized-water reactor with nuclear steam supply system designed to operate at core power levels up to 2900 megawatts-thermal, or approximately 966 megawatts-electric. Details concerning the plant and the site are found in the Updated Final Safety Analysis Report (UFSAR) for VCSNS.

This SER presents the status of the staff's review of information submitted to the NRC through September 26, 2003, the cutoff date for consideration in the SER. The staff has identified open items that must be resolved before the staff can make a determination on the application. These items are summarized in Section 1.5 of this report. In order to close these items, the staff requires the additional information identified. The staff will present its final conclusion on the review on the VCSNS application in its update to this SER.

The NRC VCSNS license renewal project manager is Rajender Auluck. Dr. Auluck may be reached at (301)-415-3936. Written correspondence should be addressed to the License Renewal and Environmental Impacts Program, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, Attention: Rajender Auluck, Mail Stop O-11F1.

THIS PAGE IS INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

THIS PAGE IS INTENTIONALLY LEFT BLANK

ABBREVIATIONS

AC	auxiliary coolant
ACI	American Concrete Institute
ACRS	Advisory Committee on Reactor Safeguards
ACSR	aluminum conductor steel reinforced
AFW	auxiliary feedwater
AISC	American Institute of Steel Construction
AMP	aging management program
AMR	aging management review
ANS	American Nuclear Society
ANSI	American National Standards Institute
APCSB	auxiliary and power conversion systems branch
ARAVS	auxiliary and radwaste area ventilation system
ART	adjusted reference temperature
AS	auxiliary system
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATWS	anticipated transient without scram
AVB	antivibration bar
AWWA	American Water Works Association
BMI	bottom-mounted instrumentation
BS	building services
BSS	building services system
BTP	branch technical position
BTRS	(boron) thermal regeneration system
B&W	Babcock and Wilcox Co.
BWR	boiling-water reactor
CASS	cast austenitic stainless steel
CBAVS	control building area ventilation systems
CC	component cooling
CCW	component cooling water
CCWS	component cooling water system
CER	condition evaluation report
CFR	*Code of Federal Regulations*
CHAMPS	component history and maintenance planning system
CLB	current licensing basis
CRD	control rod drive
CRDM	control rod drive mechanism
CREP	control room evacuation panels
CS	carbon steel
CUF	cumulative usage factor

CVCS	chemical and volume control system
CW	circulating water
DBD	design basis document
DBE	design basis event
DN	demineralized water - nuclear services
DOJ	U.S. Department of Justice
DW	demineralized water
ECCS	emergency core cooling system
ECT	eddy current testing
EDG	emergency diesel generator
EFPY	effective full power year
EO	emergency offsite facility
EOL	end of life
EPR	ethylene propylene rubber
EPRI	Electric Power Research Institute
EQ	environmental qualification or emergency equipment
EQDB	equipment qualification database
ES	engineering services
ESF	engineered safety features
FAC	flow-accelerated corrosion
FERC	Federal Energy Regulatory Commission
FHA	fire hazard analysis
FHBV	fuel handling building ventilation
FMP	fatigue monitoring program
FO	fuel oil handling
FP	fire protection
FPP	fire protection program
FRP	fiberglass reinforced plastic
FSAR	final safety analysis report
FSER	final safety evaluation report
GALL	generic aging lessons learned
GDC	general design criterion
GEIS	generic environmental impact statement
GL	generic letter
gpm	gallons per minute
GSI	generic safety issue
GSSS	gland sealing steam system
GWPS	gaseous waste processing system
HAZ	heat-affected zone

HEI	heat exchanger inspections
HELB	high energy line break
HEPA	high efficiency particulate air
HMWPE	high molecular weight polyethylene
HN	hydrogen-nuclear plant use
HV	high voltage
HVAC	heating, ventilation, and air conditioning
IBVS	intermediate building ventilation systems
IA	instrument air
IASCC	irradiation-assisted stress corrosion cracking
I&C	instrumentation and controls
ID	inside diameter
IEB	Inspection and Enforcement Bulletin
IEEE	Institute of Electrical and Electronics Engineers
IGA	intergranular attack
IGSCC	intergranular stress corrosion cracking
IN	information notice
INPO	Institute of Nuclear Power Operations
IPA	integrated plant assessment
IR	insulation resistance
ISG	Interim staff guidance
ISI	inservice inspection
ITG	issues task group or Industry
LBB	leak before break
LOCA	loss-of-coolant accident
LR	reactor building leak rate testing
LR	license renewal
LRA	license renewal application
LOTP	low-temperature overpressure protection
LTOPS	low temperature overpressure protection system
LW	liquid effluent from nuclear plant to pent stock
LWPS	liquid waste procession system
MBVCS	miscellaneous building ventilation and cooling systems
MCC	motor control center
MIC	microbiologically induced or induced corrosion
mm	millimeter
M_OS_2	molybdenum disulfide
MRP	Materials Reliability Project
MS	main steam
MSIP	mechanical stress improvement process
MSIV	main steam isolation valve
MT	magnetic particle technique

MWe	megawatt-electric
NB	nuclear blowdown processing
NCN	nonconformance notice
ND	nuclear plants drains
NDE	nondestructive examination
NDT	nil ductility temperature
NEI	Nuclear Energy Institute
NFPA	National Fire Protection Association
NG	nitrogen blanketing
NN	nitrogen-nuclear plant use
NPS	nominal pipe size
NRC	Nuclear Regulatory Commission
NSSS	nuclear steam supply system
OBE	operating-basis earthquake
ODSCC	outer diameter stress corrosion cracking
ON	oxygen-nuclear plant use
P&ID	piping and instrumentation diagram
PORV	power operated relief valve
PTS	pressurized thermal shock
P-T	pressure-temperature
PWR	pressurized water reactor
PWSCC	primary water stress corrosion cracking
QA	quality assurance
RAI	request for additional information
RBCFS	reactor building cooling and filtering systems
RBCU	reactor building cooling units
RC	reactor coolant
RCCA	rod cluster control assembly
RCDT	reactor coolant drain tank
RCP	reactor coolant pump
RCPB	reactor coolant pressure boundary
RCS	reactor coolant system
RF	refueling outage
RG	regulatory guide
RHR	residual heat removal
RPV	reactor pressure vessel
RT_{PTS}	reference temperature for pressurized thermal shock
RT_{NDT}	reference nil ductility transition temperature
RV	reactor vessel

RVI	reactor vessel internals
RVID	Reactor Vessel Integrity Database
RW	raw water
RWST	refueling water storage tank
SA	service air
SAS	safety assessment system
SBO	station blackout
SC	structure and component
SCC	stress corrosion cracking
SCE&G	South Carolina Electric and Gas Company
SE	sewer or safety evaluation
SER	safety evaluation report
SG	steam generator
SI	safety injection
SMP	structures monitoring program
SOC	Statements of Consideration
SPC	steam and power conversion
SPCS	steam and power conversion systems
SRP	Standard Review Plan
SRP-LR	Standard Review Plan — License Renewal
SS	stainless steel
SSC	structure system and component
SSE	safe shutdown earthquake
SW	service water
SWIS	service water intake structure
SWPH	service water pump/house
TDR	time domain reflectometry
TFMP	Thermal Fatigue Management Program
TLAA	time-limited aging analysis
TR	topical or technical report
TS	technical specification
UFSAR	updated final safety analysis report
USE	upper shelf energy
USI	unresolved safety issue
UT	ultrasonic testing
UV	ultraviolet
VCSNS	Virgil C. Summer Nuclear Station
VT	visual test
WCAP	Westinghouse Commercial Atomic Power

WD	radwaste solidification and solids handling
WE	waste evaporation
WG	waste gas
WL	liquid waste processing
WOG	Westinghouse Owner's Group
WPAA	west penetration access area
WX	excess liquid waste
XLPE	cross-linked polyethylene

1 INTRODUCTION AND GENERAL DISCUSSION

1.1 Introduction

This document is a safety evaluation report (SER) on the application to renew the operating license for the Virgil C. Summer Nuclear Station (VCSNS) as filed by the South Carolina Electric and Gas Company (SCE&G or the applicant). By letter dated August 6, 2002, SCE&G submitted its application to the U.S. Nuclear Regulatory Commission (NRC or the Agency) for renewal of the VCSNS operating license for up to an additional 20 years. The NRC staff (the staff) reviewed the VCSNS license renewal application (LRA) for compliance with the requirements of Title 10 of the *Code of Federal Regulations*, Part 54 (10 CFR Part 54), “Requirements for Renewal of Operating Licenses for Nuclear Power Plants,” and prepared this report to document the results of its safety review. The NRC license renewal project manager for the V.C. Summer safety review is Rajender Auluck. Dr. Auluck may be contacted by telephone at (301) 415-1025 or by electronic mail at rca@nrc.gov. Alternatively, written correspondence may be sent to the following address:

License Renewal and Environmental Impacts Program
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001
Attention: Dr. Rajender Auluck, P.E., Mail Stop O-11F1

In its August 6, 2002, submittal letter, the applicant requested renewal of the operating license issued under Section 104b of the Atomic Energy Act of 1954, as amended, for VCSNS (License No. NPF-12) for a period of 20 years beyond the current license expiration of midnight, August 6, 2022. The VCSNS Summer plant is located in Fairfield County, in predominantly rural north-central South Carolina. It is situated on the shore of Monticello Reservoir about 42 kilometers (26 miles) northwest of Columbia, the State Capital. The VCSNS unit consists of a Westinghouse pressurized-water reactor with nuclear steam supply systems designed to operate at core power levels up to 2900 megawatts-thermal, or approximately 966 megawatts-electric. Details concerning the plant and the site are found in the updated final safety analysis Report (UFSAR) for VCSNS.

The license renewal process proceeds along two tracks, the first of which is a technical review of safety issues and the second, an environmental review. The requirements for these two reviews are stated in 10 CFR Parts 54 and 51, respectively. The safety review is based on the VCSNS LRA and on the applicant's answers to requests for additional information (RAIs) from the NRC staff. In meetings and docketed correspondence, SCE&G has also supplemented its answers to the RAIs. Unless otherwise noted, the staff reviewed and considered information submitted through September 26, 2003. The public may review the LRA and all pertinent information and material, including the UFSAR, at the NRC Public Document Room, 11555 Rockville Pike, Rockville, MD 20852-2738. In addition, the VCSNS LRA and significant information and material related to the license renewal review are available on the NRC’s web page at www.nrc.gov.

This SER summarizes the findings of the staff's safety review of the VCSNS LRA and describes the technical details considered in evaluating the safety aspects of the proposed operation of the plant for up to an additional 20 years beyond the term of the current operating license. The

staff reviewed the LRA in accordance with NRC regulations and the guidance presented in the NRC's, "Standard Review Plan for the Review of License Renewal Applications for Nuclear Power Plants (SRP-LR)," which was issued as NUREG-1800 in July 2001.

Sections 2 through 4 of the SER document the staff's evaluation of license renewal issues that have been considered during the review of the LRA. Section 5 is reserved for the report of the Advisory Committee on Reactor Safeguards (ACRS). The conclusions of this report are in Section 6.

Appendix A of this SER is a table that identifies the applicant's commitments associated with the renewal of the operating license. Appendix B is a chronology of the principal correspondence between the NRC and the applicant related to the review of the LRA. Appendix C is a bibliography of the references used during the course of the review. The NRC staff principal reviewers and its contractors for the SER are listed in Appendix D.

In accordance with 10 CFR Part 51, the staff is required to prepare a draft for comment and a final plant-specific supplement to the generic environmental impact statement (GEIS). The supplement discusses the environmental considerations related to renewing the license for VCSNS. The draft plant-specific supplement to the GEIS was issued separately from this report. Specifically, NUREG-1437, Supplement 15, "Generic Environmental Impact Statement for License Renewal of Nuclear Plant Regarding Virgil C. Summer Nuclear Station," issued July 11, 2003, and is the draft environmental impact statement for VCSNS.

1.2 License Renewal Background

Pursuant to the Atomic Energy Act of 1954, as amended, and NRC regulations, licenses for commercial power reactors to operate are issued for up to 40 years. These licenses can be renewed for up to 20 additional years. The original 40-year license term was selected on the basis of economic and antitrust considerations, rather than on technical limitations. However, some individual plant and equipment designs may have been engineered on the basis of an expected 40-year service life.

In 1982, the NRC anticipated interest in license renewal and held a workshop on nuclear power plant aging that led the NRC to establish a comprehensive program plan for nuclear plant aging research. On the basis of the results of that research, a technical review group concluded that many aging phenomena are readily manageable and do not pose technical issues that would preclude extending the life of nuclear power plants. In 1986, the NRC published a request for comment on a policy statement that would address major policy, technical, and procedural issues related to license renewal for nuclear power plants.

In 1991, the NRC published the license renewal rule in 10 CFR Part 54. The NRC participated in an industry-sponsored demonstration program to apply the rule to a pilot plant and to develop experience to establish implementation guidance. To establish a scope of review for license renewal, the rule defined age-related degradation unique to license renewal. However, during the demonstration program, the NRC found that many aging mechanisms occur and are managed during the period of the initial license. In addition, the NRC found that the scope of the review did not allow sufficient credit for existing programs, particularly for the implementation of the maintenance rule, which also manages plant aging phenomena.

As a result, in 1995, the NRC amended the license renewal rule. The amended 10 CFR Part 54 establishes a regulatory process that is simpler, more stable, and more predictable than the previous license renewal rule. In particular, 10 CFR Part 54 was amended to focus on managing the adverse effects of aging, rather than on identifying age-related degradation unique to license renewal. The rule changes were intended to ensure that important systems, structures, and components (SSCs) will continue to perform their intended functions during the period of extended operation. In addition, the integrated plant assessment (IPA) process was clarified and simplified to be consistent with the revised focus on passive, long-lived structures and components (SCs).

In parallel with these efforts, the NRC pursued a separate rulemaking effort to amend 10 CFR Part 51 to focus the scope of the review of the environmental impacts of license renewal and to fulfill, in part, the NRC's responsibilities under the National Environmental Policy Act of 1969 (NEPA).

1.2.1 Safety Reviews

License renewal requirements for power reactors are based on two principles:

(1) The regulatory process is adequate to ensure that the licensing bases of all currently operating plants provides and maintains an acceptable level of safety, with the possible exception of the detrimental effects of aging on the functionality of certain SSCs during the period of extended operation, as well as a few other issues related to safety during the period of extended operation.

(2) The plant-specific licensing basis must be maintained during the renewal term in the same manner and to the same extent as during the original licensing term.

In implementing these two principles, the rule in 10 CFR 54.4 (the Rule) defines the scope of license renewal as including those plant SSCs (1) that are safety-related, (2) whose failure could affect safety-related functions, and (3) that are relied on to demonstrate compliance with the NRC's regulations for fire protection (FP), environmental qualification (EQ), pressurized thermal shock (PTS), anticipated transients without scram (ATWS), and station blackout (SBO).

Pursuant to 10 CFR 54.21(a), the applicant for a renewed license must review all SSCs that are within the scope of the Rule to identify SCs that are subject to an aging management review (AMR). SCs that are subject to an AMR are those that perform an intended function without moving parts, or without a change in configuration or properties, and that are not subject to replacement based on a qualified life or specified time period. As required by 10 CFR 54.21(a), an applicant for a renewed license must demonstrate that the effects of aging will be managed in such a way that the intended function or functions of the SCs that are within the scope of license renewal will be maintained, consistent with the current licensing basis (CLB), for the period of extended operation. Active equipment, however, is considered to be adequately monitored and maintained by existing programs. In other words, the detrimental effects of aging that may affect active equipment are more readily detectable and will be identified and corrected through routine surveillance, performance monitoring, and maintenance activities. The surveillance and maintenance programs for active equipment, as well as other aspects of

maintaining the plant design and licensing basis, are required to continue throughout the period of extended operation.

Pursuant to 10 CFR 54.21(d), each LRA is required to include a supplement to the Final Safety Analysis Report (FSAR). This FSAR supplement must contain a summary description of the applicant's programs and activities for managing the effects of aging.

Another requirement for license renewal is the identification and updating of time-limited aging analyses (TLAAs). During the design phase for a plant, certain assumptions are made about the length of time the plant will be operated. These assumptions are incorporated into the design calculations for several of the plant's SSCs. In accordance with 10 CFR 54.21(c)(1), these calculations must be shown to be valid for the period of extended operation or the must be projected to the end of the period of extended operation, or the applicant must demonstrate that the effects of aging on these SSCs will be adequately managed for the period of extended operation.

In 2001, the NRC developed and issued Regulatory Guide 1.188, "Standard Format and Content for Applications to Renew Nuclear Power Plant Operating Licenses." This guide endorses an implementation guideline prepared by the Nuclear Energy Institute (NEI) as an acceptable method of implementing the license renewal rule. NEI 95-10, Revision 3, "Industry Guideline for Implementing the Requirements of 10 CFR Part 54 — The License Renewal Rule," was issued in March 2001. The NRC also prepared the SRP-LR which was used to review this application.

SCE&G is the fourth license renewal applicant to fully utilize the process defined in NUREG-1801, "Generic Aging Lessons Learned (GALL) Report," dated July 2001. The purpose of GALL is to provide the staff with a summary of staff-approved aging management programs (AMPs) for the aging of most SCs that are subject to an AMR. If an applicant commits to implementing these staff-approved AMPs, the time, effort, and resources used to review an applicant's LRA will be greatly reduced, thereby improving the efficiency and effectiveness of the license renewal review process. The GALL Report summarizes the aging management evaluations, programs, and activities credited for managing aging for most of the structures and components used throughout the industry. The report also serves as a reference for both applicants and staff reviewers to quickly identify those AMPs and activities that the staff has determined will provide adequate aging management during the period of extended operation.

1.2.2 Environmental Reviews

In December 1996, the staff revised the environmental protection regulations in 10 CFR Part 51 to facilitate environmental reviews for license renewal. The staff prepared a "Generic Environmental Impact Statement (GEIS) for License Renewal of Nuclear Plants" (NUREG-1437, Revision 1) to document its evaluation of the possible environmental impacts associated with renewing licenses of nuclear power plants. For certain types of environmental impacts, the GEIS establishes generic findings that are applicable to all nuclear power plants. These generic findings are identified as Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B. Pursuant to 10 CFR 51.53(c)(3)(i), an applicant for license renewal may incorporate these generic findings in its environmental report. Analyses of environmental impacts of license renewal that must be evaluated on a plant-specific basis, Category 2 issues,

are required to be included in an environmental report in accordance with 10 CFR 51.53(c)(3)(ii).

In accordance with NEPA and the requirements of 10 CFR Part 51, the NRC performed a plant-specific review of the environmental impacts of license renewal, including whether there is new and significant information exist that was not considered in the GEIS. A public meeting was held on December 11, 2002, at VCSNS as part of the NRC's scoping process to identify environmental issues specific to the plant. The results of the environmental review and a preliminary recommendation on the license renewal action were documented in NRC draft plant-specific Supplement 15 to the VCSNS GEIS, which was issued on July 11, 2003, for VCSNS. After consideration of comments on the draft, the NRC will prepare and publish a final plant-specific supplement to the GEIS.

1.3 Principal Review Matters

The requirements for renewing operating licenses for nuclear power plants are described in 10 CFR Part 54. The staff performed its technical review of the VCSNS LRA in accordance with Commission guidance and the requirements of 10 CFR Part 54. The standards for renewing a license are contained in 10 CFR 54.29. This SER describes the results of the staff's safety review.

In 10 CFR 54.19(a), the Commission requires a license renewal applicant to submit general information. The applicant provided this general information in Chapter 1 of its LRA for VCSNS, submitted by letter dated August 6, 2002. The staff finds that the applicant has submitted the information required by 10 CFR 54.19(a) in Section 1 of the LRA.

In 10 CFR 54.19(b), the Commission requires that LRA include "conforming changes to the standard indemnity agreement, 10 CFR 140.92, Appendix B, to account for the expiration term of the proposed renewed license." The applicant stated the following in Section 1.3.8 of its LRA regarding this issue:

> The current indemnity agreement (No. B-86) for VCSNS states in Article VII that the agreement shall terminates at the time of expiration of the license specified in Item 3 of the Attachment to the agreement, which is the last to expire. Item 3 of the Attachment to the indemnity agreement, as revised by Amendment No. 2 lists two license numbers (SNM-1834 and NPF-12). SCE&G requests that conforming changes be made to Article VII of the indemnity agreement, and Item 3 of the Attachment to the agreement, specifying the extension of the agreement until the expiration date of the renewed VCSNS facility operating license as sought in this application. In addition, should the license numbers be changed upon issuance of the renewal license, SCE&G requests that conforming changes be made to Item 3 of the attachment, and any other sections of the indemnity agreement as appropriate.

The staff intends to maintain the original license number upon issuance of the renewed license. Therefore, there is no need to make conforming changes to the indemnity agreement, and the requirements of 10 CFR 54.19(b) have been met.

In 10 CFR 54.21, the Commission requires that each application for a renewed license for a nuclear facility contain the following information, (1) an IPA, (2) current licensing basis changes that have occurred during staff review of the LRA, (3) an evaluation of TLAAs, and (d) an UFSAR supplement. Sections 3 and 4 and Appendix B of the LRA address the license renewal

requirements of 10 CFR 54.21(a) and (c). The license renewal requirements of 10 CFR 54.21(d) are in Appendix of the LRA.

In 10 CFR 54.21(b), the Commission requires that each year following submittal of the application, and at least 3 months before scheduled completion of the staff's review, an amendment to the renewal application must be submitted that identifies any changes to the CLB of the facility that materially affect the contents of the LRA, including the UFSAR Supplement. The applicant submitted an update to the LRA in a letter dated July 31, 2003, which summarizes changes to the CLB that have occurred at VCSNS during the staff's review of the LRA. This submittal satisfies the requirements of 10 CFR 54.21(b) and is still under staff review.

In 10 CFR 54.22, the Commission states requirements regarding technical specifications. In Appendix D of the LRA, the applicant stated that no technical specification changes had been identified as being necessary to support issuance of the renewed operating licenses for VCSNS. This adequately addresses the requirements of 10 CFR 54.22.

The staff evaluated the technical information required by 10 CFR 54.21 and 10 CFR 54.22, in accordance with the NRC's regulations and the guidance provided by the SRP-LR. The staff's evaluation of the LRA in accordance with 10 CFR 54.21 and 54.22 is contained in Sections 2, 3, and 4 of this SER.

The staff's evaluation of the environmental information required by 10 CFR 54.23 will be found in the final plant-specific supplement to the GEIS. This document will state the considerations related to renewing the license for VCSNS and will be prepared by the staff separate from this report. When the report of the ACRS, required by 10 CFR 54.25, is issued, it will be incorporated into Section 5 of this SER. The findings required by 10 CFR 54.29 will be made in Section 6 of this SER.

1.3.1 Westinghouse Topical Reports

In the LRA the applicant did not utilize the Westinghouse topical reports that other companies with similar technologies have used for AMR. The only references to any Westinghouse Commercial Atomic Power (WCAP) reports are in Sections 3 and 4 and Appendix B of the LRA and in responses to requests for additional information. In accordance with 10 CFR 54.17(e), the applicant referenced the following WCAP reports in the LRA.

- WCAP-12866, "Bottom Mounted Instrumentation Flux Thimble Wear," 1991.
- WCAP-13480, Revision 1, "Westinghouse Delta 75 Steam Generator Design and Fabrication Information for the Virgil C. Summer Nuclear Station," October 1993.
- WCAP-14422, Revision 2-A, "License Renewal Evaluation: Aging Management for Reactor Coolant Supports," December 2000.
- WCAP-14535A, "Topical Report on Reactor Coolant Pump Flywheel Inspection Elimination," November 1996.

- WCAP 14574-A,“License Renewal Evaluation: Aging Management Evaluation for Pressurizers,” December 2000.

- WCAP-14577, Rev. 1-A, "License Renewal Application: Aging Management Evaluation for Reactor Internals," March 2001.

- WCAP-14575-A, “Aging Management Evaluation for Class 1 Piping and Associated Pressure Boundary Components,” August 1996.

- WCAP-15101, “Analysis of Capsule W from the South Carolina Electric & Gas Company V. C. Summer Unit 1 Reactor Vessel Radiation Surveillance Program,” dated September 1998.

- WCAP-15103, “Evaluation of Pressurized Thermal Shock for V. C. Summer Unit 1,” September 1998.

- WCAP-15666, "Extension of Reactor Coolant Pump Motor Flywheel Examination,” Rev. 0, Non-Proprietary Class 3, July 2001.

The safety evaluations of the topical reports are intended to be stand-alone documents. An applicant that incorporates the topical reports by reference into an LRA must ensure that the conditions of approval stated in the safety evaluations are met.

1.4 Interim Staff Guidance

The license renewal program is a living program. The staff, industry, and other interested stakeholders gain experience and develop lessons learned with each renewed license. The lessons learned address the Agency’s performance goals of maintaining safety, improving effectiveness and efficiency, reducing regulatory burden, and increasing public confidence. The lessons learned are captured in interim staff guidance (ISG) for use by the staff and interested stakeholders until the improved license renewal guidance documents are revised.

The current set of relevant ISGs that have been issued by the staff, and the SER sections in which the issues are addressed by staff, is provided in the following table:

ISG Issue (**Approved ISG No.)**	**Purpose**	**SER Section**
Station Blackout (SBO) Scoping **(ISG-02)**	The license renewal rule 10 CFR 54.4(a)(3) includes 10 CFR 50.63(a)(1) — SBO. The SBO rule requires that a plant must withstand and recover from an SBO event. The recovery time for offsite power is much faster than that of EDGs. The offsite power system should be included within the scope of license renewal.	3.6.2.4.2 3.6.2.4.3
Concrete Aging Management Program **(ISG-03)**	Lessons learned from the GALL demonstration project indicate that GALL is not clear whether concrete needs any AMPs.	3.5.2.2.1 3.5.2.4.2
Fire Protection (FP) System Piping **(ISG-04)**	To clarify staff position for wall thinning of FP piping system in GALL AMPs (XI.M26 and XI.M27). New position is that there is no need to disassemble FP piping, as oxygen can be introduced in the FP piping which can accelerate corrosion. Instead, use nonintrusive method such as volumetric inspection. Testing of sprinkler heads should be performed every 50 years and 10 years after initial service. Eliminated Halon/carbon dioxide system inspections for charging pressure, valve line ups, and automatic mode of operation test from GALL. The staff considers these test verifications to be operational activities.	3.0.3.3 3.3.2.4.8

ISG Issue (Approved ISG No.)	Purpose	SER Section
Identification and Treatment of Electrical Fuse Holder **(ISG-05)**	To include fuse holder AMR and AMP (i.e., same as terminal blocks and other electrical connections). The position includes only fuse holders that are not inside the enclosure of active components (e.g., inside of switchgears and inverters). Operating experience finds that metallic clamps (spring-loaded clips) have a history of age-related failures from aging stressors such as vibration, thermal cycling, mechanical stress, corrosion, and chemical contamination. The staff finds that visual inspection of fuse clips is not sufficient to detect the aging effects from fatigue, mechanical stress, and vibration.	3.6.2.3.1

1.5 Summary of Open Items

As a result of its review of the LRA for VCSNS, including additional information submitted to the NRC through September 26, 2003, the staff has determined that there are no open issues which would require further discussions with the applicant.

1.6 Summary of Confirmatory Items

As a result of it's review of the LRA for VCSNS, including the additional information and clarifications that were submitted by the applicant to the NRC through September 26, 2003, the staff has determined that there are no confirmatory issues which would require formal response to the NRC staff.

1.7 Summary of Proposed License Conditions

As a result of the staff's review of the VCSNS application for license renewal, including the additional information and clarifications provided by the applicant, the staff identified two proposed license conditions. The first license condition requires the applicant to include the UFSAR Supplement in the next UFSAR update required by 10 CFR 50.71(e) following issuance of the renewed license. The second license condition requires that the future activities identified in the UFSAR Supplement be completed prior to the period of extended operation.

THIS PAGE IS INTENTIONALLY LEFT BLANK

2 SCOPING AND SCREENING METHODOLOGY FOR IDENTIFYING STRUCTURES AND COMPONENTS SUBJECT TO AGING MANAGEMENT REVIEW, AND IMPLEMENTATION RESULTS

This section documents the staff's review of the methodology used by the applicant to identify structures, systems, and components (SSCs) that are within the scope of the Maintenance Rule - 10 CFR 50.65 (Rule), and to identify structures and components (SCs) that are within the scope of the Rule and are subject to an aging management review (AMR). SCs subject to an AMR are those that perform an intended function, as described in 10 CFR 54.4, and meet two criteria:

1.9 They perform such functions without moving parts or without a change in configuration or properties, as set forth in 10 CFR 54.21(a)(1)(i) (denoted as "passive" SCs).

1.10 They are not subject to replacement based on a qualified life or specified time period, as set forth in 10 CFR (a)(1)(ii) (denoted as "long-lived" SCs).

The identification of the SSCs within the scope of license renewal is called "scoping." For those SSCs within the scope of license renewal, the identification of "passive," "long-lived" SCs that are subject to an AMR is called "screening."

The staff's review of the scoping and screening methodology is presented in Section 2.1 of this SER. The staff's review of the results of the implementation of the scoping and screening methodology is presented in Sections 2.2 through 2.5 of this SER.

By letter dated August 6, 2002, the applicant submitted its request and application for renewal of the operating license for V.C. Summer nuclear Station (VCSNS). As an aid to the staff during the review, the applicant provided evaluation boundary drawings that identify the functional boundaries for systems and components within the scope of license renewal. These evaluation boundary drawings are not part of the license renewal application (LRA).

On March 28, 2003, the staff issued final requests for additional information (F-RAIs) regarding the applicant's methodology for identifying SSCs at VCSNS that are within the scope of license renewal and subject to an AMR, and the results of the applicant's scoping and screening process. By letters dated June 12, 2003, the applicant provided responses to the F-RAIs.

The staff conducted a scoping and screening inspection from June 23 – 27, 2003, to examine activities that supported the LRA, including the inspection of procedures and representative records and interviews with personnel regarding the process of scoping and screening plant equipment to select SSCs within the scope of the Rule and subject to an AMR. The results of the team inspection are contained in Inspection Report 50-395/03-07, dated June 13, 2003. On this basis, the U.S. Nuclear Regulatory Commission (NRC) staff concluded that the applicant's scoping and screening process was successful in identifying those SSCs required to be considered for aging management. In addition, for a sample of plant systems, the inspection team performed visual examinations of accessible portions of the systems to observe any effects of equipment aging. Finally, the inspection concluded that the scoping and screening portion of the applicant's license renewal activities were conducted as described in the LRA and that documentation supporting the application is in an auditable and retrievable form.

2.1 Scoping and Screening Methodology

2.1.1 Introduction

Part 54 of Title 10 of the *Code of Federal Regulations*, (CFR), "Requirements for Renewal of Operating Licenses for Nuclear Power Plants," Section 54.21, "Contents of Application — Technical Information," requires that each application for license renewal contain an integrated plant assessment (IPA). Furthermore, the IPA must list and identify those SCs that are subject to an AMR from the SSCs that are within the scope of license renewal in accordance with 10 CFR 54.4.

In Section 2.1, "Scoping and Screening Methodology," of the LRA, the applicant described the scoping and screening methodology used to identify SSCs for the VCSNS that are within the scope of license renewal and SCs that are subject to an AMR, pursuant to 10 CFR 54.21(a)(1). The staff reviewed the applicant's scoping and screening methodology to determine if it meets the scoping requirements stated in 10 CFR 54.4(a) and the screening requirements stated in 10 CFR 54.21. In developing the methodology, the applicant considered the requirements of the Rule, including the statements of consideration and the guidance presented by the Nuclear Energy Institute (NEI), "Industry Guideline for Implementing the Requirements of 10 CFR Part 54 - The License Renewal Rule," Revision 3, March 2001 (NEI 95-10). In addition, the applicant also considered the NRC staff's correspondence with other applicants and with NEI in the development of this methodology.

2.1.2 Summary of Technical Information in the Application

In Sections 2.0 and 3.0 of the LRA, the applicant provides the technical information required by 10 CFR 54.21(a). In Section 2.1, "Scoping and Screening Methodology," the applicant describes the process used to identify the SSCs that meet the license renewal scoping criteria under 10 CFR 54.4(a), as well as the process used to identify the SCs that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

Additionally, Section 2.2, "Plant Level Scoping Results," Section 2.3, "System Scoping and Screening Results: Mechanical," Section 2.4, "Structures and Structural Components Scoping and Screening Results," and Section 2.5, "Scoping and Screening Results: Electrical and Instrumentation and Control," of the LRA amplify the process that the applicant used to identify the SCs that are subject to an AMR. Chapter 3 of the LRA, "Aging Management Review," contains the following information—Section 3.1, "Aging Management of Reactor Vessel, Internals, and Reactor Coolant System," Section 3.2, "Aging Management of Engineered Safety Features," Section 3.3, "Aging Management of Auxiliary Systems," Section 3.4, "Aging Management of Steam and Power Conversion Systems," Section 3.5, "Aging Management of Containments, Structures, and Component Supports," and Section 3.6, "Aging Management of Electrical and Instrumentation and Controls." Chapter 4, "Time-Limited Aging Analysis," contains the applicant's identification and evaluation of time-limited aging analyses (TLAAs).

2.1.2.1 Scoping Methodology

The IPA scoping process used by the applicant was performed for both plant and system level scoping. The first step was the identification of all plant systems and structures as described in

Section 2.1.1, "Plant Level Scoping," of the LRA. For those systems and structures determined to be in scope, a system level scoping was performed to identify the components within the systems or structures which support their intended functions. The system level scoping step was performed to compile a list of SCs that contribute to the ability to perform the intended functions identified during the process for scoping of plant systems and structures.

2.1.2.1.1 Application of the Scoping Criteria in 10 CFR 54.4(a)

In Section 2.1.1 of the LRA, the applicant discussed the scoping methodology as it related to safety-related criteria in accordance with 10 CFR 54.4(a)(1), non-safety-related criteria in accordance with 10 CFR 54.4(a)(2), and 10 CFR 54.4(a)(3) for regulated events. In Section 2.1.1.2, "Safety-Related Criteria Pursuant to 10 CFR 54.4(a)(1)," of the LRA, the applicant discussed the scoping methodology as it related to safety-related criteria in accordance with 10 CFR 54.4(a)(1). The applicant stated that SSCs within the scope of license renewal include safety-related SSCs, which are those relied upon to remain functional during and following design basis events (DBEs), as defined in 10 CFR 50.49(b)(1). The applicant initially relied on the use of specific component information contained in the component history and maintenance planning system (CHAMPS) and the environmental qualification (EQ) databases to identify safety-related SCs credited with remaining functional during and following DBEs defined in the current licensing basis (CLB). With regard to the system level scoping, the applicant stated that a system was initially identified as being in scope if one or more of the following criteria were met:

- The system performs an intended function as described in the applicable system design basis documents (DBDs) or in the Rule scoping step.

- The component data indicates that failure of a non-safety-related system could prevent safety-related systems from fulfilling their functions.

- The system is relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations pursuant to 10 CFR 54.4(a)(3), or has been identified in one of the applicant's reports which provided a detailed evaluation of the plant with respect to the requirements of 10 CFR 54.4(a)(2).

With regard to structure level scoping, all safety-related structures at VCSNS are designated as Seismic Category I and are within the scope of license renewal. The classification of each structure has been previously determined and documented in the updated final safety analysis report (UFSAR).

In Section 2.1.1.3, "Non-Safety Related Criteria Pursuant to 10 CFR 54.4(a)(2)," of the LRA, the applicant discussed the scoping methodology as it related to the non-safety-related criteria in accordance with 10 CFR 54.4(a)(2). The applicant stated that a review was performed to identify the non-safety-related SSCs whose failure could prevent satisfactory accomplishment of the safety-related intended functions identified in 10 CFR 54.4(a)(1). The applicant also stated that all non safety-related SSCs whose failure could prevent satisfactory accomplishment of any of the functions identified in 10 CFR 54.4(a)(1)(i), (ii), or (iii), are also within the scope of license renewal. Additionally, non-safety-related systems and structures and non-safety-related portions of safety-related systems and structures whose physical failure could damage

equipment that is performing a safety function and preventing it from performing that function are also within scope pursuant to 10 CFR 54.4 (a)(2). During the applicant's preparation of the LRA, additional guidance emerged from the NRC regarding scoping of seismic II/I piping systems and the identification and treatment of SSCs which meet 10 CFR 54.4(a)(2). To address the staff's concern in this area, the applicant stated in Section 2.1.1.3.1 of the LRA that the review of insulation, ductwork, and piping would be provided later in a supplementary submittal to the NRC. The applicant stated that they are participating in current industry efforts to develop a methodology to address issues related to these components.

In Section 2.1.1.4, "Regulated Events Pursuant to 10 CFR 54.4(a)(3)," of the LRA, the applicant discussed the scoping methodology as it related to the regulated event criteria in accordance with 10 CFR 54.4(a)(3). The applicant reviewed all SSCs relied on in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations, pursuant to 10 CFR 54.4(a)(3), for fire protection, EQ, pressurized thermal shock, anticipated transients without scram (ATWS), and station blackout (SBO) to ensure they were adequately accounted for in the scoping methodology. This involved an extensive review of safety evaluation reports, the VCSNS Fire Protection Evaluation Report (FPER), the UFSAR, DBDs, licensee event technical reports, licensing correspondence, and other design and licensing documentation. To support this review, the applicant developed a set of reports which provided detailed design information for certain regulated events. The reports describe the regulatory requirements, the system descriptions, and specific equipment relied on to comply with the requirements including components and structures.

2.1.2.1.2 Documentation Sources Used for Scoping and Screening

In Section 2.1.1 of the LRA, the applicant stated that the information sources relied upon in performing scoping and screening activities included the UFSAR, technical specifications, docketed licensing correspondence, DBDs, CLB, piping and instrumentation diagrams (P&IDs), the FPER, the SBO Coping Plan, and specific component information for SSCs contained in CHAMPS and the EQ databases. CHAMPS is a controlled database that contains as-built information on a component level and consists of multiple data fields for each component, such as design-related information, safety and seismic classifications, safety classification bases, and component tag, type, and description information. The EQ database is a controlled database that consists of multiple data fields for each component or subcomponent, such as component identification, vendor, vendor model number, Regulatory Guide (RG) 1.97 category, mild or harsh environment category, and maintenance requirements. In addition, the Rule includes scoping criteria for non-safety-related SSCs which are similar to the license renewal scoping criterion.

Flow diagrams were used to delineate the mechanical systems screening boundaries and also reflect American Society of Mechanical Engineers (ASME) Code boundaries and quality grouping classifications. For vendor-supplied skid mounted packages, vendor drawings were used to assist in the scoping and screening reviews. The drawings reflect the SSCs within a skid package and the interfaces with the system it supports as outlined in the flow diagrams discussed above. These sources were also used to develop the list of SSCs subject to an AMR. The applicant used this information to identify the functions performed by plant systems and structures and then compared this to the scoping criteria in 10 CFR 54(a)(1-3) to determine if the associated plant SC performed a license renewal intended function. Additionally, 25

technical reports, prepared specifically for license renewal, formed the basis documentation for the LRA.

2.1.2.1.3 Plant and System Level Scoping

In Section 2.1.1 of the LRA, the applicant discussed the scoping methodology as it related to the safety-related criteria in accordance with 10 CFR 54.4(a)(1), non-safety-related criteria in accordance with 10 CFR 54.4(a)(2), and other scoping criteria in accordance with 10 CFR 54.4(a)(3) for regulated events. The scoping process used to identify systems and structures that satisfy the requirements of 10 CFR 54.4(a)(1-3) is performed using documents which form the CLB and other information sources. The CLB for the VCSNS has been defined in accordance with the definition provided in 10 CFR 54.3. The key information sources that form the CLB include the UFSAR, technical specifications, and docketed licensing correspondence. The aspects of the scoping process used to identify SSCs that satisfy the requirements of 10 CFR 54.4(a)(1-3) are described in Subsections 2.1.1.2, 2.1.1.3, and 2.1.1.4 of the LRA.

After the applicant identified the intended functions of systems or structures within the scope of license renewal, a review was performed to determine which components of each in-scope system and structure supported license renewal intended functions. The components that supported intended functions were considered within the scope of license renewal and screened to determine if an AMR was required. The applicant considered mechanical, structural, and electrical component classifications during this stage of the scoping methodology. For mechanical components, the applicant established evaluation boundaries, determined components within those boundaries, and identified component intended functions. This was accomplished by highlighting the flow paths, including the pressure boundary, on the system drawings, and reviewing the P&IDs. The applicant verified that the mechanical components identified within the highlighted portions of these boundary drawings were within the scope of license renewal. All passive, long-lived mechanical components or component groupings developed used plant system flow diagrams, design guidelines, and the plant component database for consistency with standard plant usage. For structures, the applicant verified the evaluation boundaries, which included the entire building and its foundation, as identified on the civil structural drawings, to be within the scope of license renewal. The applicant also verified that electrical equipment within mechanical systems or structures considered within the scope of license renewal were carried forward as electrical commodity groups and then screened for long-lived passive components.

Guidance contained in American Nuclear Society (ANS) ANS N18.2, "Nuclear Safety Criteria for the Design of Stationary Pressurized Water Reactor Plants" August 1970 Draft, RG 1.143, "Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water Cooled Nuclear Power Plants" November 2001, and RG 1.29, "Seismic Design Classification" were used by the applicant to establish those SSCs that satisfy the scoping criteria in 10 CFR 54.4(a)(1). These plant SSCs are designated as Seismic Category I in conformance with the recommendations of RG 1.29 for the balance of plant. Nuclear steam supply system fluid system components important to safety are also classified in accordance with ANS N18.2. Plant mechanical systems and components are categorized by safety classification with system components or portions of systems having different classifications. System piping classifications are shown on mechanical system flow diagrams.

At VCSNS, Categories 1, 2a, 2b, 3, non-nuclear safety, and quality-related have been established for the classification of components and are defined in the UFSAR. These categories are based on ANS safety classes and reflect both safety-related and non-safety-related classifications. Comparison of the ANS N18.2 safety class criteria, as implemented at VCSNS, to the criteria of 10 CFR 54.4(a)(1), shows that the safety classes encompass the systems and equipment that meet the criteria of 10 CFR 54.4(a)(1)(i), (ii), and (iii). Scoping of mechanical systems and mechanical portions of nonmechanical systems relies primarily on the ANS N18.2 safety classifications. All safety-related mechanical systems, and mechanical portions of nonmechanical systems, are considered to be within the scope of the Rule. The system flow diagrams contain boundary flags which identify the safety classification of the applicable components. Mechanical systems and components required for compliance with 10 CFR 54.4(a)(1) is shown in Section 2.2 of the LRA. On the basis of discussions with the applicant's engineering staff cognizant of the scoping and screening process, and a review of selected design documentation in support of the process, the staff concluded that the applicant's staff understood the requirements and adequately implemented the scoping and screening methodology established in the LRA.

2.1.2.1.4 Component Level Scoping

After the applicant identified systems and structures within the scope of license renewal, and their associated intended functions, the applicant performed a review to identify the components of each in-scope system and structure subject to an AMR. The scoping methodology for each component classification is discussed below.

<u>Mechanical Component Scoping</u>

The applicant based the scoping activities on currently maintained flow diagrams which use design basis information and DBDs to provided the basis for those mechanical systems meeting the criteria of 10 CFR 54.4(a)(1, 2, or 3). The applicant used the guidance contained in RG 1.26 and RG 1.29 to establish those mechanical systems which met the scoping criteria of 10 CFR 54.4(a)(1). Piping Classes 1, 2a, 2b, and 3 were designated as safety-related and subject to the requirements of 10 CFR 54.4(a)(1). The applicant identified the safety-related mechanical boundaries using the flow diagrams. As defined by 10 CFR 54.4(a)(1-3), those mechanical systems and components which are required to mitigate DBEs, or the failure of which would prevent the successful mitigation of DBEs, or which are relied on in safety analyses or plant evaluations to perform a function that demonstrates compliance with the NRC's regulated events are all within the scope of license renewal. DBEs are defined in 10 CFR 50.49 (b)(1) and include conditions of normal operation, including anticipated operational occurrences, design basis accidents, external events, and natural phenomena. Non-safety-related mechanical systems, including non-nuclear safety-related and quality-related systems, that functionally support safety-related system function(s), or whose failure could prevent the performance of a required intended function, are within the scope of license renewal. This equipment may have already been identified by systems-interaction studies, by classification of equipment as anti-falldown (seismic II/I), or by other considerations such as flooding or heavy loads. To identify those applicable non-safety-related systems from the appropriate reference documents, VCSNS staff located plant information sources that identify the non-nuclear safety-related and quality-related systems which directly support the function of a safety-related system or whose failure could prevent the performance of a required intended

function. Technical information related to scoping activities was then incorporated into the technical report in accordance with VCSNS procedures.

Structures Scoping

Structures at VCSNS are classified as either nuclear or non-nuclear safety-related. The safety-related structures are designed to withstand the safe shutdown earthquake (SSE) and are classified as Seismic Category I, while the non-safety-related structures, generally not designed to SSE seismic levels, are classified as non-seismic. The classification of each structure has been previously determined and documented in the UFSAR. A listing of structures within the scope of license renewal is located in Section 2.2 of the LRA. All non-safety-related SSCs whose failure could prevent satisfactory accomplishment of any of the functions identified in 10 CFR 54.4(a)(1)(i), (ii), or (iii) are also within the scope of license renewal. Two types of systems and structures must be considered for inclusion within the scope of license renewal per 10 CFR 54.4(a)(2) — (1) Non-safety-related systems and structures, and non-safety-related portions of safety-related systems and structures whose physical failure could damage equipment that is performing a safety function and prevent it from performing that function and (2) non-safety-related SSCs whose failure could prevent satisfactory accomplishment of any of the functions identified in 10 CFR 54.4(a)(1)(i), (ii), or (iii). Structural supports that are considered to meet seismic or anti-falldown criteria or code break criteria are within the scope of license renewal. These are not included in the mechanical system scoping and screening but are treated as a structural commodity.

Electrical and Instrumentation and Control Component Scoping

Electrical components at VCSNS are classified as either Class 1E, as defined in Institute of Electrical and Electronics Engineers (IEEE) IEEE-380, "Definitions of Terms Used in IEEE Standards on Nuclear Power Generating Stations," or as non-nuclear safety. Class 1E is the safety classification of the electrical equipment and systems that are essential to emergency reactor shutdown, containment isolation, reactor core cooling, and containment and reactor heat removal, or are otherwise essential in preventing significant release of radioactive material to the environment. These functions are the electrical equivalent to the functions specified in the scoping criteria in 10 CFR 54.4(a)(1). All electrical systems that contain equipment classified as Class 1E are considered to be safety-related and are within the scope of license renewal. Class 1E equipment is identified through a review of the VCSNS component database. The listing of electrical systems and components required for compliance with 10 CFR 54(a)(1) is found in Section 2.2 of the LRA. Electrical systems and portions of electrical systems that are non-safety-related but whose failure could prevent the satisfactory accomplishment of any of the functions identified in 10 CFR 54.4(a)(1)(i), (ii), and (iii) are within the scope of license renewal pursuant to 10 CFR 54.4(a)(2). The electrical equipment and components that perform these functions are designated as quality-related and are identified as such in the VCSNS equipment database.

2.1.2.2 Screening Methodology

Following the determination of SSCs within the scope of license renewal, the applicant implemented a process for determining which SCs, contained in the SSCs which were determined to be within scope, would be subject to an AMR in accordance with the requirements of 10 CFR 54.21(a)(1). In Section 2.1.2, "Screening Methodology," of the LRA,

the applicant discussed these screening activities as they relate to the in-scope SSCs. The specific screening activities for the various engineering disciplines are further described in the application in Section 2.1.2.1 for mechanical systems, Section 2.1.2.2 for structures, and Section 2.1.2.3 for electrical and instrumentation and control (I&C) components. These screening activities consisted of the identification of passive components, long-lived components, component intended functions, consumables, and component replacement based on performance or condition. The applicant relied on the guidance in Appendix B to NEI 95-10 and Chapter 2 of NUREG-1800, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants," April 2001 (SRP-LR), to develop the plant-specific listing of passive components of interest during the review.

2.1.2.2.1 Mechanical Component Screening

Following component level scoping for mechanical systems, the applicant performed screening, in accordance with Section 2.1.2.1 of the LRA, to identify those mechanical components that were subject to an AMR. The applicant stated that the mechanical screening process was implemented on each of the systems that were identified during the scoping review phase to identify the passive mechanical components that support one or more of the system's intended functions. The system's intended functions, in conjunction with component information in CHAMPS, regulated event reports, and the applicable system drawings, have been used to identify the passive components within the scope of license renewal. For mechanical systems, the screening process is performed on each system identified to be within the scope of license renewal. The process includes the establishment of system evaluation boundaries, determination of components within those boundaries, the identification of component intended functions, the determination of components subject to an AMR, and the identification of commodity groups (material and environment identification). Mechanical system evaluation boundaries are established for each system within the scope of license renewal to assure that all components required to support system intended functions, which meet the requirements of 10 CFR 54.4(a)(1, 2 and/or 3), are considered for an AMR. These boundaries are determined by mapping the flow paths, including pressure boundary, that are necessary for the accomplishment of identified system intended functions onto the system flow diagrams or other drawings, such as UFSAR figures. The mechanical components found within the mapped portions of these boundary drawings comprise the complete set of mechanical components within the scope of license renewal. A menu listing all passive long-lived mechanical components or component groupings was developed based on the guidance in Appendix B to NEI 95-10. The components within the mapped areas of the license renewal evaluation boundary diagrams for each system are compared to the menu as a step in listing the components that are subject to an AMR.

A list of potential mechanical component intended functions is then developed for each grouping of the components within the mechanical evaluation boundaries. In accordance with 10 CFR 54.21(a)(1), component intended functions are those component level functions that are performed without moving parts or without a change in configuration or properties in support of identified system intended functions. The result is a list of the potential intended functions for each passive long-lived component type. Each mechanical component or component group (commodity) within the license renewal evaluation boundaries is reviewed to determine whether the potential intended functions must be performed by that component to meet the requirements that are necessary to ensure that the identified system intended

functions for license renewal are accomplished. The functions that must be performed are the actual component intended functions.

Consistent with the screening criterion of 10 CFR 54.21(a)(1)(i), only in-scope components that perform an intended function without moving parts or without a change in configuration or properties are subject to an AMR. Of these, components that are not subject to replacement based on a qualified life or specified time period, pursuant to 10 CFR 54.21(a)(1)(ii), are identified and documented as subject to an AMR. All other components in the scope of license renewal are screened out. Mechanical indicating devices and electrical components that form an integral part of the pressure-retaining boundary are subject to an AMR. Many components are grouped together so that a single AMR is performed based on common characteristics, such as material or environment. For each mechanical component and component type (commodity) subject to an AMR, the internal and external operating environments to which the component is subjected are established based on a review of plant design documents, the UFSAR, plant drawings, and plant environmental data. The materials of construction for the components and component types subject to an AMR are determined based on a similar review of plant documentation. Components with similar design, materials of construction, and subjected to similar environments within an individual system are evaluated as a commodity group. Commodity groups are not used for components with unique design characteristics, such as heat exchangers, pumps, and tanks, or Class 1 sub-components.

2.1.2.2.2 Structures Component Screening

Section 2.1.2.2 of the LRA describes the methodology used to screen civil/structural components, subject to an AMR, in accordance with 10 CFR 54.21(a)(1). The structural components within the scope of 10 CFR Part 54 were reviewed to determine those components. The purpose of structures screening was to identify the types of long-lived passive structural items (e.g., hangers, cable trays, equipment supports, base plates, specialty doors, curbs, penetration assemblies, jet shields, and instrument racks and frames) that support the intended function of the structure. An AMR of a structural component is required if the component performs an intended function without moving parts or without a change in configuration or properties (i.e., passive), and if it is not subject to replacement on the basis of a qualified life or specified time period (i.e., long-lived). Screening has been performed by the applicant for each structure identified as being within the scope of license renewal.

To facilitate the identification of the structural components subject to an AMR, the applicant established structure evaluation boundaries which included the entire building, foundation, slabs, external and internal walls, roof, and steel columns and beams. Other long-lived passive items within the building, such as structural supports (e.g., hangers, cable trays, miscellaneous supports), equipment supports and base plates, specialty doors, curbs, penetration assemblies, jet shields, and instrument racks and frames, are grouped as structural component types and are subject to an AMR. A comprehensive list of the types of structural components that exist within VCSNS evaluation boundary is developed based on a review of plant documentation, including design drawings, specifications, DBDs, the UFSAR, and the component database. For concrete structures and structural components, VCSNS has used the 10 CFR Part 54 process, NUREG-1801, and industry guidelines to determine those specific aging effects that are applicable and require an AMR for the extended period of operation.

A list of potential structural component intended functions was developed using the guidance in NEI 95-10 for each of the component types within the structural evaluation boundaries based on the intended functions of the structure. For each passive, long-lived structural component, the potential intended functions are reviewed to determine which of the functions could be performed by the structural component type. The result is a list of the potential intended functions for each passive, long-lived component type. Each structural component of the identified component types is reviewed to determine whether the potential intended functions must be performed by that structural component to meet the requirements that are the basis for including the component within the scope of license renewal. The functions that must be performed are the actual component intended functions. The passive, long-lived structural components that perform at least one component intended function are subject to an AMR. To establish commodity groupings, the structural components are divided into major groupings based on materials of construction and operating environment. For each structural component subject to an AMR, the internal and external operating environments to which the component is subjected are established. Operating environments are established based on a review of plant design documents, the UFSAR, and plant drawings. Components with similar design, materials of construction, functions, and subjected to similar environments are evaluated as a commodity group.

2.1.2.2.3 Electrical and Instrumentation and Control Component Screening

Following component level scoping for electrical and I&C systems, the applicant performed screening to identify those electrical and I&C components that were subject to an AMR. In Section 2.1.2.3 of the LRA, the applicant described the methodology used to screen electrical and I&C components. The methodology used to determine which components are subject to an AMR is organized differently than for the mechanical and structural evaluations. The primary difference in the methodology is the order in which the component screening steps are performed. Electrical equipment contained in mechanical systems or structures considered within the scope of license renewal are carried forward as electrical commodities. Component commodity groups are established at the start of the process and the screening criteria are applied to the commodity groups. Since most electrical and I&C components are active, this method provides the most efficient means for determining the components that require an AMR, which is consistent with the guidance in NEI 95-10. The listing of commodity groups for electrical and I&C components in Appendix B to NEI 95-10 is used as the starting point for the establishment of electrical commodity groups.

The initial listing of electrical commodity groups is compared to plant design information to ensure that all electrical and I&C components are included. The intended functions for each of the electrical commodity groups are then identified. The electrical components groupings are adjusted, as necessary, based on similar design and function attributes. The intended functions established for each of the electrical commodity groups are compared with the criteria of 10 CFR 54.21(a)(1)(i) and (ii). The electrical and I&C components commodity groups that perform an intended function without moving parts or without a change in configuration or properties are identified based on the guidance in Appendix B to NEI 95-10. The passive electrical commodity groups that are not subject to replacement based on a qualified life or specified time period are identified as requiring an AMR. The applicant selected this method since most electrical and I&C components are active. The initial listing of electrical commodity groups is compared to plant design information to ensure that all electrical and I&C components are included. After identifying the SSCs within the scope of license renewal, the applicant also

performed a screening review to determine which electrical components would be subject to an AMR. As part of this effort, the applicant relied on the requirements set forth in 10 CFR 54.21(a)(1)(i) and (ii) as supplemented by industry guidance to identify component intended functions for each electrical commodity group. All of the other electrical and I&C commodities identified are either active, subject to replacement based on a qualified life or specified time period, or do not perform any intended functions and therefore, are not subject to an AMR pursuant to 10 CFR 54.21(a)(1)(i) and industry guidance. The electrical screening results are presented in the LRA which provides a description for each of the electrical and I&C component types subject to an AMR, along with their component intended functions.

2.1.2.2.4 Commodity Groups Screening

The applicant used commodity groups as a method to evaluate certain components which share similar materials, perform the same intended functions, and operate under similar environmental conditions for many systems. For each mechanical and structural component and component type (commodity) subject to an AMR, the internal and external operating environments to which the component is subjected are established. Operating environments are established based on a review of plant design documents, the UFSAR, vendor drawings, specifications, plant drawings, and environmental data. The materials of construction for the components and component types subject to an AMR are determined based on a review of similar plant documents. Components with similar design, materials of construction, and subjected to similar environments within an individual system are evaluated as a commodity group (e.g., pipe). Commodity groups are not used for components with unique design characteristics, such as heat exchangers, pumps, and tanks, or Class 1 sub-components.

For electrical components, the intended functions for each of the electrical commodity groups and active and passive determinations, are based on the guidance in NEI 95-10. The intended functions established for each of the commodity groups are compared with the criteria of 10 CFR 54.21(a)(1)(i) and (ii). The electrical and I&C components commodity groups that perform an intended function without moving parts or without a change in configuration or properties are identified. Active and passive screening determinations are also based on the guidance in NEI 95-10. The passive electrical commodity groups that are not subject to replacement based on a qualified life or specified time period are identified as requiring an AMR.

2.1.3 Staff Evaluation

As part of the review of the applicant's LRA, the NRC staff evaluated the scoping and screening activities described in Section 2.1, "Scoping and Screening Methodology," to ensure that the applicant described a process for identifying SSCs that are within the scope of license renewal in accordance with the requirements of 10 CFR 54.4(a)(1-3). In addition, the NRC staff conducted a scoping and screening methodology audit at the VCSNS from January 28–31, 2003. The focus of the audit was to ensure that the applicant had developed and implemented adequate guidance to conduct the scoping and screening of SSCs in accordance with the methodologies described in the LRA and the requirements of the Rule. The audit team reviewed procedures and engineering reports which describe the scoping and screening methodology implemented by the applicant. In addition, the audit team conducted detailed discussions with the cognizant staff on the implementation and control of the program and

reviewed administrative control documentation used by the applicant during the scoping and screening process. The team further reviewed a sample of system scoping and screening results reports for the auxiliary feedwater, component cooling water, main steam, and main feedwater systems to ensure the methodology outlined in the administrative controls was appropriately implemented and the results reports were consistent with the CLB, as described in the supporting design documentation.

For mechanical components, the applicant established evaluation boundaries, determined components within those boundaries, and identified component intended functions. This was accomplished by highlighting flow paths on the system drawings and verifying that the mechanical components, identified within the highlighted portions of the boundary drawings, were within the scope of license renewal. All passive, long-lived mechanical components or component groupings were developed using plant system flow diagrams, design guidelines, and the plant component database. For structures, the team verified the evaluation boundaries of structures, identified on the civil structural drawings, to be within the scope of license renewal. The evaluation boundary of structures considered within the scope of license renewal included the entire building and its foundations. The team also verified that electrical equipment within mechanical systems or structures considered within the scope of license renewal were carried forward as electrical commodity groups and then screened for long-lived passive components.

2.1.3.1 Evaluation Methodology for Identifying Systems, Structures, and Components Within the Scope of License Renewal

In Section 2.1.1 of the LRA, the applicant discussed the scoping methodology related to the safety and non-safety-related criteria and regulated events in compliance with 10 CFR 54.4(a)(1–3). The scoping process used to identify systems and structures that satisfy these requirements is performed using documents which form the CLB and other plant information sources. The CLB for the VCSNS has been defined in accordance with the definition provided in 10 CFR 54.3. The key information sources that form the CLB include the UFSAR, technical specifications, and docketed licensing correspondence. The aspects of the scoping process used to identify SSCs that satisfy the requirements of the Rule are described in Subsections 2.1.1.2, 2.1.1.3, and 2.1.1.4, respectively, of the LRA.

The staff reviewed implementation procedures and engineering reports which describe the scoping methodology implemented by the applicant. These procedures included VCSNS Technical Report (TR) TR00160-001, "Mechanical Systems Scoping for License Renewal," dated July 3, 2002; TR00170-001, "Structures Scoping for License Renewal," dated July 3, 2002; TR00150-001, "Electrical Systems Scoping for License Renewal," dated July 3, 2002; Engineering Services Procedures (ES) ES-701, "Mechanical System Scoping for License Renewal," Revision 1, dated July 31, 2000; ES-703, "Mechanical Component Aging Management Review for License Renewal," Revision 2, dated July 8, 2002; ES-704, "Electrical Systems Scoping, Screening, and Aging Management Review," Revision 2, dated February 5, 2002; ES-705, Civil/Structural Scoping, Screening, and Aging Management Review for License Renewal," Revision 2, dated September 24, 2001; and ES-706, "Identification and Evaluation of Time Limited Aging Analyses and Exemptions for License Renewal," Revision 2.

The staff found that the scoping methodology instructions were consistent with Section 2.1 of the LRA and were of sufficient detail to provide the applicant's staff with concise guidance on

the scoping and screening implementation process to be followed during the LRA activities. In addition to the implementing procedures, the staff reviewed supplemental design information including DBDs, system drawings, and selected licensing documentation, which were relied upon by the applicant during the scoping and screening phases of the review. The staff found these design documentation sources to be useful for ensuring that the initial scope of SSCs identified by the applicant was consistent with the CLB.

2.1.3.1.1 Application of the Scoping Criteria in 10 CFR 54.4(a)

10 CFR 54.4(a)(1)

An applicant must consider all safety-related SSCs which are relied upon to remain functional during and following DBEs to ensure the following functions — (1) the integrity of the reactor coolant pressure boundary, (2) the ability to shut down the reactor and maintain it in a safe shutdown condition, or (3) the capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposures comparable to those referred to in 10 CFR 50.34(a)(1), 10 CFR 50.67(b)(2), or 10 CFR Part 100.11, to be within the scope of the license renewal. The applicant's process used to scope safety-related SSCs is described in several engineering procedures that require a search of CLB documentation (e.g., DBDs, UFSAR, and the CHAMPS database) to identify systems and structures that meet the safety-related criteria. The staff reviewed a sample of the applicant's safety-related components and CHAMPS database tables to ensure that the applicant had adequately captured those components. The staff reviewed CHAMPS and other documentation to sort through the equipment data system records. The documentation reviewed provided concise tables of component records on the basis of safety classification or specific intended functions of interest, such as EQ and fire protection.

In Section 2.1.1.2 of the LRA, the applicant stated in the table that :

> Plant systems, structures, and components within the scope of this part are -- (1) Safety-related systems, structures, and components which are those relied upon to remain functional during and following design-basis events (as defined in 10 CFR 50.49(b)(1)) to ensure the following functions -- ... (iii) The capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposures comparable to those referred to in §50.34(a)(1), §50.67(b)(2), or §100.11 of this chapter, as applicable.

However during the scoping and screening audit, the staff noted that Procedures TR00160-001,TR00170-001, and TR00150-001 cited superseded regulatory text in establishing the scoping criteria to be used in identifying SSCs in accordance with 10 CFR Part 54.4(a)(1) requirements. Specifically referenced in the Procedures, 10 CFR 54.4(a)(1)(iii) states:

> The capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposure comparable to those referred to in the 10 CFR Part 100 guidelines.

On March 28, 2003, the staff requested in RAI 2.1-1 that the applicant provide an evaluation that addressed the impact, if any, of not having explicitly considered in its scoping methodology those SSCs that are relied upon to ensure compliance with 10 CFR 50.49(b)(1)(iii), consistent with the CLB. In its response dated June 12, 2003, the applicant stated that the text in the technical reports (comparable to the 10 CFR Part 100 guidelines) was taken from the original Rule (May 8, 1995) as published in NEI 95-10 which was later amended on December 11, 1996, to read, "comparable to those referred to in 10 CFR 50.34(a)(1) or §100.11 of this

chapter, as applicable." Another change was made on December 23, 1999, to make the Rule read "comparable to those referred to in 10 CFR 50.34(a)(1), 10 CFR 50.67(b)(2), or 10 CFR 100.11 of this chapter, as applicable." The applicant stated that this change had no impact on how scoping was done and that 10 CFR Part 100.11 is the specific section of Part 100 that VCSNS used to define the site boundary and allowable doses to the public.

The staff also reviewed various documentation and discussed the methodology and results with the applicant's cognizant staff during the audit. The staff verified that the applicant had identified and used pertinent engineering and licensing information in order to determine the SSCs required to be in scope in accordance with 10 CFR 54.4(a)(1). The staff also reviewed a sample of the license renewal database 10 CFR 54(a)(1) scoping results, reviewed a sample of the analyses and documentation to support these reviews, and discussed the methodology and results with the applicant's personnel responsible for these evaluations. The staff verified that the applicant had identified and used pertinent engineering and licensing information in order to determine the SSCs required to be in scope in accordance with the 10 CFR 54.4(a)(1) criteria. On the basis of this sample review, the staff's onsite audit, discussions with the applicant, and review of the applicant's response to the staff's RAI, the staff determined that the applicant's methodology for identifying systems and structures meeting the scoping criteria of 10 CFR 54(a)(1) was adequate. Therefore, RAI 2.1-1 is considered closed.

<u>10 CFR 54.4(a)(2)</u>

In Section 2.1.1.3.1 of the LRA, the applicant provided a discussion of the methodology used to evaluate SSCs with respect to the 10 CFR 54.4(a)(2) criteria. The applicant's methodology consisted of the following:

- a review of all LRA boundary drawings including those drawings extending beyond the scope of the license renewal boundaries

- a review of completed plant level scoping and screening evaluations

- review of systems and their drawings for identified systems that were not within the scope of license renewal

- walkdowns of plant areas to identify the potential interactions

- review of design drawings to determine the potential for interference of non-safety-related SCs with safety-related SCs in instances where the drawing were of sufficient detail to preclude the need to perform a physical plant walkdown

- review of industry and plant specific operating history of non-safety-related piping and components to determine if further consideration of non safety-related versus safety-related is required

The applicant's review initially encompassed all seismic II/I and non-seismic II/I systems containing either steam or liquid as well as non-fluid-filled (i.e., air/gas) systems. With respect to the non-fluid-filled systems, the applicant performed a review of NRC generic communications and industry operating experience associated with non-fluid-filled systems and did not identify any instances of failures due to age-related degradation of these systems which

could prevent safety-related equipment from performing their intended functions. The review of plant-specific operating experience associated with non-fluid-filled systems also did not identify any instances of such failures. As a result, no additional SSCs were brought into scope for non- fluid-filled systems. For the remaining fluid-filled systems, all were included in the supplemental review except for those systems which could not have an effect on safety-related SSCs due to their location being remote (i.e., being physically separated from) from such safety-related SSCs.

The staff reviewed the plant equipment database to identify non-safety-related components that could have an impact on the ability of nuclear safety-related SSCs to perform their required functions. In addition, the Maintenance Rule includes scoping criteria for non-safety-related SSCs which are similar to the license renewal scoping criterion. The staff reviewed several of these information sources and verified that the applicant had adequately incorporated the results of these efforts into the scoping methodology reports. The staff also discussed with the applicant the current interim staff guidance (ISG) regarding the 10 CFR 54.4(a)(2) issue, including the December 3, 2001, and March 15, 2002, letters to NEI which discussed the staff's position. The ISG discusses two types of systems and structures that must be considered for inclusion within the scope of license renewal per 10 CFR 54.4(a)(2) — (1) Non-safety-related systems and structures, and non-safety-related portions of safety-related systems and structures whose physical failure could damage equipment that is performing a safety function and prevent it from performing that function and (2) non-safety-related SSCs whose failure could prevent satisfactory accomplishment of any of the functions identified in 10 CFR 54.4(a)(1)(i), (ii), or (iii).

The letters described the areas to be considered and options the staff expects applicants to use to determine what SSCs meet the (a)(2) criterion. The December letter provided specific examples of operating experience which identified pipe failure events (summarized in NRC Information Notice (IN) 2001-09, "Main Feedwater System Degradation in Safety-Related ASME Code Class 2 Piping Inside the Containment of a Pressurized Water Reactor") and the approaches the staff considers acceptable to determine which piping systems should be included in scope. The March letter further described the staff's expectations for the evaluation of non-piping SSCs to determine which additional non safety-related SSCs are within scope. The position states that applicants should not consider hypothetical failures but rather should base their evaluation on the plant's CLB, engineering judgement and analyses, and relevant operating experience.

During the applicant's preparation of the LRA, additional guidance was developed by the NRC regarding scoping of seismic II/I piping systems and the identification and treatment of SSCs which meet 10 CFR 54.4(a)(2). To address the staff's concerns discussed in the NEI letters and the ISG, the applicant stated in Section 2.1.1.3.1 of the LRA that the review of insulation, ductwork, and piping would be provided later to the staff in a supplementary submittal. On September 12, 2002, the applicant submitted to the staff its results of previously non-analyzed piping and duct work to address the staff's concerns. The results were documented in TR00160-018, "Refined 10 CFR Part 54.4(a)(2) Criteria Evaluations for License Renewal," Revision 0, dated September 6, 2002. The reevaluation focused on AMRs of non-nuclear safety-related piping whose failure may adversely impact nuclear safety-related equipment and components due to spatial interactions (i.e., physical impact, pipe whip, jet impingement, leakage and spray). Non-fluid containing mechanical system portions, as well as nonmechanical SSCs, were also addressed for completeness. In this submittal the applicant

stated that systems containing non-nuclear safety-related and/or quality-related components that meet the 10 CFR 54.4(a)(2) criteria were identified with respect to spatial interactions that could adversely affect the performance of a safety-related function during the period of extended operation. The results contained a list of systems having components which met the 10 CFR 54.4(a)(2) criteria. Included were 34 in-scope mechanical systems that had their scope expanded to include non-nuclear safety and quality-related portions that have a potential for adverse spatial interactions with nuclear safety-related equipment in certain designated buildings, as well as 11 additional systems added to scope. The staff's review of the applicant's scoping results and aging management evaluation of SCs in these systems is presented in Sections 2.3.5 and 3.05 of this SER, respectively.

On the basis of the additional information supplied by the applicant, the staff concludes that the applicant has applied sufficient scoping criteria to demonstrate that all SSCs that meet the 10 CFR 54.4(a)(2) scoping requirements are identified. This information included expansion of the systems within the scope of license renewal, the addition of new portions of systems within scope as a result of the revised methodology, determination of the credible failures which could impact the ability of safety-related SSCs from performing their intended functions, evaluation of relevant operating experience, incorporation of identified non-safety-related SSCs into the applicant's AMPs, and the results of NRC inspection and audit activities.

<u>10 CFR 54.4(a)(3)</u>

In addition to those SSCs relied upon to mitigate DBEs or whose failure could prevent mitigation of such events, the systems that are credited to support compliance with NRC regulations identified in 10 CFR 54.4(a)(3) must be identified for license renewal. This requires that the applicant consider all SSCs relied on in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for fire protection (10 CFR 50.48), EQ (10 CFR 50.49), pressurized thermal shock (10 CFR 50.61), ATWS (10 CFR 50.62), and SBO (10 CFR 50.63) to be within the scope of the license renewal.

The staff reviewed several evaluations and source documents prepared by the applicant to demonstrate compliance with each of the regulated events of interest in accordance with the regulations. The applicant's evaluations focused on identifying and verifying that specific systems or structures were relied upon in response to the particular regulated event. The applicant reviewed all SSCs relied on in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations to ensure they were included in the scoping methodology. This involved an extensive review of safety evaluation reports, the UFSAR, licensee event technical reports, licensing correspondence, the EQ list, and other design and licensing documentation.

The staff reviewed reports developed by the applicant which provided detailed design information for certain regulated events and included an RG-1.154 evaluation to verify SSCs met the pressurized thermal shock (PTS) criteria, docketed correspondence to address regulatory commitments on ATWS, including documentation to support the installation of the ATWS mitigation system actuation circuitry control system, and for SBO, the applicant developed a coping plan to address the Rule. The reports described the regulatory requirements, system descriptions, and specific equipment relied on to comply with the requirements, including components and structures. For fire protection, the staff reviewed the FPER which contained additional analyses on the essential elements of the program, including

the fire hazards analysis, safe plant shutdown description, and a point-by-point comparison of the program with the requirements of Appendix A to NRC Branch Technical Position APCSB, "Guidelines for Fire Protection for Nuclear Power Plants Docketed Prior to July 1, 1976," dated August 23, 1976.

The staff also discussed the methodology and results with the applicant's cognizant staff, reviewed a sample of the license renewal database 10 CFR 54.4(a)(3) scoping results, reviewed a sample of the analyses and documentation to support these reviews, and discussed the methodology and results with the applicant's personnel responsible for these evaluations. The staff verified that the applicant had an acceptable process to identify and use pertinent engineering and licensing information in order to determine the SSCs required to be in scope. Based on this review, the staff determined that the applicant's methodology for identifying systems and structures meeting the scoping criteria of 10 CFR 54(a)(3) was adequate.

2.1.3.1.2 Plant Level Scoping of Systems and Structures

To accomplish license renewal scoping, the applicant's engineering procedures incorporated the methodology used to identify systems and structures within the scope of license renewal. The applicant developed various system DBDs to assure plant engineering had a verified source of detailed design information for plant systems and selected internal and external events and anticipated operational occurrences, such as internal and external missiles, high energy line breaks, fire protection, and seismic criteria. The staff reviewed a sample of the DBD reports for both safety-related and non-safety-related systems to better understand the approach used by the applicant to determine which SSCs would be initially placed in scope for license renewal. The DBDs provide a concise, well documented discussion of the system, including safety-related, non-safety-related, and NRC required functions, and also included brief descriptions of system operation during normal and off-normal conditions, system maintenance, and system and component design basis requirements.

Included in each DBD was a detailed list of the sources of information which included specific sources such as the UFSAR, technical specifications, calculations and analyses, as well as non-plant-specific sources such as industry codes and standards, NUREGs, regulatory guides, inspection and enforcement bulletins, notices, generic letters, and Commission orders. The DBD documentation is controlled and maintained in accordance with the applicant's site quality assurance program. The staff reviewed the governing procedures and administrative controls and determined that they presented adequate guidance for the preparation, control, and maintenance of the DBDs. The applicant also explained the development of various procedures and technical reports prepared by the applicant's engineering staff to help ensure that the scoping process identified and considered for inclusion in the scope of the LRA, all SSCs in the CLB that address the requirements of 10 CFR 54.4(a)(1-3).

For scoping of structural components, the staff reviewed ES-705, "Civil/Structural Scoping, Screening, and Aging Management Review for License Renewal," Revision 2, dated September 24, 2001, which provided instructions for implementing the scoping and screening review processes for structures and structural components in accordance with the requirements of 10 CFR 54.4. The staff also reviewed TR00170-001, "Structures Scoping for License Renewal," dated July 3, 2002, and TR00170-002, "Structures Screening for License Renewal," dated July 3, 2002, which provided additional guidance. The applicant developed the structural scoping process in accordance with the guidance contained in NEI 95-10 and also developed a

list of structures derived from VCSNS document sources and included the master list in TR00170-001. Structures within this list were evaluated against the 10 CFR 54.4(a) criteria to determine those structures within the scope of license renewal. As stated in the LRA with respect to structures meeting the requirements of 10 CFR 54.4(a)(1), all structures were classified according to their design function and the degree of structural integrity required to ensure the health and safety of the public.

The applicant noted that Appendix A to 10 CFR 100, "Seismic and Geological Siting Criteria for Nuclear Power Plants," requires that all nuclear power plants be designed such that, if an SSE occurs, certain SSCs remain functional. These SSCs are those necessary to ensure (1) the integrity of the reactor coolant pressure boundary, (2) the capability to shut down the reactor and maintain it in a safe shutdown condition, or (3) the capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposures comparable to the guideline exposures of 10 CFR Part 100. These three functions meet the requirements specified in the scoping criteria in 10 CFR 54.4(a)(1). The specific structures that are required to ensure these functions are satisfactorily implemented are identified in RG 1.29 as Seismic Category I. All safety-related structures identified through a review of the UFSAR are designated as Seismic Category I and are within the scope of license renewal. The applicant also listed each in-scope system or structure and provided a detailed description of the intended function(s) and the specific rule criteria the intended function satisfied. The staff determined that the applicant had adequately captured the system intended functions from those source documents and appropriately identified which 10 CFR 54.4 rule criteria that each intended function satisfied.

2.1.3.1.3 System Level Scoping

VCSNS procedures ES-701, ES-704, and ES-705 provide the detailed instructions for determining which of the many mechanical systems at VCSNS are within scope. Generally, the scoping process described is at the system level for the majority of the SSCs. Because several different criteria are included in 10 CFR 54.4, separate background material and guidance is provided in the applicable subsections for each of the different criteria.

Mechanical Component Scoping

In Section 2.1.1 of the LRA, the applicant discussed the scoping methodology as it related to safety-related criteria in accordance with 10 CFR 54.4(a)(1), non-safety-related criteria in accordance with 10 CFR 54.4(a)(2), and other scoping in accordance with 10 CFR 54.4(a)(3) for regulated events. The applicant stated that a system was initially identified as being in scope if one or more of the following criteria were met:

- The system performs an intended function as described in the applicable system DBDs or in the Rule scoping step.

- The component data indicates that failure of a non-safety-related system could prevent safety-related systems from fulfilling their safety-related functions.

- The system is relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations pursuant to 10 CFR 54.4(a)(3), or has been identified in one of the applicant's reports which

provided a detailed evaluation of the plant with respect to the requirements of 10 CFR 54.4(a)(2).

The staff reviewed the applicant's methodology used to identify SSCs relied upon to remain functional during and following DBEs (as defined in 10 CFR 50.49(b)(1)) to ensure the following functions – (1) the integrity of the reactor coolant pressure boundary, (2) the capability to shut down the reactor and maintain it in a safe shut down condition, or (3) the capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposure comparable to the guidelines in 10 CFR 50.34(a)(1), 10 CFR 50.67(b)(2), or 10 CFR 100.11 of this chapter, as applicable. The applicant initially relied on the use of specific component information contained in CHAMPS and the EQ databases to identify safety-related components and structures credited with remaining functional during and following DBEs defined in the CLB. Several information sources were utilized for the identification of non-nuclear safety-related SSCs that meet the requirements of 10 CFR 54.4(a)(2). The plant equipment database identifies components that are not directly nuclear safety-related but that could have an impact on the ability of nuclear safety-related SSCs to perform their required functions.

Structures Scoping

The staff reviewed ES-705, which provided instructions for implementing the scoping and screening review processes for structures and structural components in accordance with the requirements of 10 CFR 54.4. The staff also reviewed TR00170-001 and TR00170-002, which provided additional guidance on structures scoping and screening, and documented the results. VCSNS developed the structural scoping process in accordance with the guidance contained in NEI 95-10 and compiled the list of structures from several document sources including the UFSAR, site facility drawings, DBDs, and plant walkdowns, and referenced such structures in the master list of structures included in TR00170-001. The structures within this list were evaluated against the 10 CFR 54.4(a) criteria to determine those structures within the scope of license renewal. For compliance with 10 CFR 54.4(a)(1), all structures were classified in the LRA according to their design function and the degree of structural integrity required to ensure the health and safety of the public. The classification of each structure has been previously determined and documented in UFSAR Table 3.2-2, "Classification of Structures." Category I structures are identified through a review of the UFSAR. Nuclear safety-related structures had been previously identified and all remained in scope.

For 10 CFR 54.4(a)(2), structures were classified as either nuclear safety-related or non-nuclear safety-related. The safety-related structures are designed to withstand the SSE and are classified as Seismic Category I, while the non-safety-related structures are generally not designed to withstand SSE seismic levels and are classified as non-seismic. Systems and components that have been seismically mounted to meet anti-falldown (seismic II/I) criteria are classified as Seismic Category II. There are no structures designated as Seismic Category II at VCSNS. Non-safety-related structures whose failure could impair the function of safety-related SSCs are designated as non-seismic but have been designed to withstand earthquake and tornado loads to the extent required for prevention of damage to Seismic Category I structures. The staff reviewed the portion of the master list which had not been identified as nuclear safety-related for potential impact on safety-related components. The applicant identified three structures which met the requirements of 10 CFR 54.4(a)(2) which were subsequently brought into scope. One structure, the north berm for flood pool which was not included in the Rule scoping, was scoped in for license renewal purposes and also added to the Rule. The

applicant also identified two structures which were brought into scope for potential structural failure due to seismic or wind.

For 10 CFR 54.4(a)(3), the staff performed a sample review of safety evaluation reports, the UFSAR, DBDs, technical reports, calculations, technical requirement packages, licensing correspondence files, and other appropriate design documents to verify that the scoping methodology demonstrated compliance with the Commission's regulations.

Electrical and Instrumentation and Control Component Scoping

The staff reviewed Sections 2.1.1.2.3 and 2.1.1.3.3 of the LRA to determine that the applicant identified the electrical components within the scope of license renewal in accordance with 10 CFR 54.4 and subject to an AMR, in accordance with the requirements of 10 CFR 54.21(a)(1). The staff discussed the methodology with applicant representatives and reviewed various documents including ES-704, TR00150-001, and TR00150-002. These documents describe the scoping and screening process used by the applicant to identify electrical components subject to an AMR and present the results of that process. The applicant assumed that all electrical systems were within the scope of license renewal unless a specific scoping evaluation was performed that demonstrated otherwise. The purpose of electrical system scoping was to identify those electrical systems which did not meet the requirements of 10CFR 54.4(a)(1-3) and, therefore, did not contain any components within the scope of license renewal. In addition, many electrical components were assigned to mechanical systems (not electrical systems). Following scoping, all electrical components were recombined into electrical commodity groups where they were reviewed as part of the commodity group and not as part of the system. The scoping evaluation described the system, component, or commodity group functions and then evaluated these functions against the scoping criteria of 10 CFR 54.4(a). Those systems which were classified as "1E" were included within the scope in accordance with 10 CFR 54.4(a)(1). The determination of which systems would be within scope in accordance with 10 CFR 54.4(a)(2) was based upon the VCSNS definition of quality-related as detailed in the system technical requirements packages and also from the Rule system worksheets. All electrical systems relied upon to perform a function in compliance with NRC requirements for regulated events were also included within scope.

For all other scoping criteria, the applicant reviewed all SSCs relied on in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations, pursuant to 10 CFR 54.4(a)(3), to ensure they were adequately accounted for in the scoping methodology. This involved an extensive review of SERs, the FPER, the UFSAR, DBDs, licensee event technical reports, licensing correspondence, and other design and licensing documentation. To support this review, the applicant developed a set of reports which provided detailed design information for each regulated event. The reports described the regulatory requirements, the system descriptions, and specific equipment relied on to comply with the requirements including components and structures.

2.1.3.2 Evaluation Methodology for Identifying Structures and Components Subject to an Aging Management Review

After the applicant identified systems and structures within the scope of license renewal and their associated intended functions, a review was performed to identify the components of each in-scope system and structure subject to an AMR. To accomplish this, the staff reviewed

implementation procedures and engineering reports which described the screening methodology implemented by the applicant. These procedures included ES-427, "Program Screening," Revision 1; ES-702, "Mechanical Component Screening for License Renewal," Revision 1, dated July 31, 2000; ES-703, "Mechanical Component Aging Management Review for License Renewal," Revision 2, dated July 8, 2002; ES-704, ES-705, and ES-706, "Identification and Evaluation of Time Limited Aging Analyses and Exemptions for License Renewal," Revision 2. The staff also reviewed the methodology used by the applicant to identify mechanical, structural, and electrical components within the scope of license renewal that would be subject to an AMR. The applicant provided the staff with a detailed discussion of the processes used for each discipline and provided technical reports that described the screening methodology as well as a sample of the engineering analyses for a selected group of safety-related and non-safety-related systems.

2.1.3.2.1 Mechanical Component Screening

Following identification of the SSCs within the scope of license renewal, the applicant performed a screening review to determine which mechanical components would be subject to an AMR in accordance with 10 CFR 54.21(a)(1). An AMR of a mechanical component is required if the component performs an intended function without moving parts or without a change in configuration or properties (i.e., passive) and if it is not subject to replacement on the basis of a qualified life or specified time period (i.e., long-lived). The staff reviewed the screening methodology which involved the establishment of license renewal evaluation boundaries, determination of components within those boundaries, identification of mechanical components subject to an AMR, and identification of the intended functions of each component or component group. Identification of the components subject to an AMR was performed using plant system flow diagrams, equipment databases, and the guidance of Appendix B to NEI 95-10. The intended functions were determined based on the system level function which had been the basis for including the system within the scope of license renewal and the component function which is required to enable the system to perform its intended function. The staff also reviewed the methodology used by the applicant to identify and list the mechanical components subject to an AMR, as well as the applicant's technical justification for this methodology.

The staff reviewed the implementation of this methodology by reviewing a sample of the mechanical systems identified as being within the scope. The systems included safety injection, component cooling water, main feedwater, and emergency feedwater. This included a review of the evaluation boundaries drawn within those systems on the P&IDs, the resulting components determined to be within the scope of the Rule, the corresponding component level intended functions, and the resulting list of mechanical components subject to an AMR. The staff reviewed the applicant's methodology for establishment of system evaluation boundaries, reviewed applicable procedures outlining the process, verified portions of the diagrams, and held discussions with the responsible members of the applicant's LRA staff. The initial step in the component screening process was to establish the license renewal boundaries for each system within the scope of license renewal, (i.e., the physical or functional boundaries that are required to support identified system intended functions). Precise physical and functional boundaries were necessary to assure that all components and component groups required to support system intended functions were considered for inclusion. The system evaluation boundaries were established by highlighting on system flow diagrams and other pertinent drawings the flow paths that are involved with the system intended functions identified in TR00160-001 and all other portions of the system that meet the scoping criteria of

10 CFR 54.4(a)(1-3). Once the system evaluation boundaries were established, the subject components or component types (commodities) located within the evaluation boundaries were determined as described in ES-702. From the list of potential intended functions provided in ES-702, the actual intended functions of the subject components were determined by reviewing the UFSAR, system DBDs, and other appropriate design and licensing documents. Actual intended functions were those that passively support the system intended functions provided in TR00160-001. Based on this sample review of portions of the above listed systems, applicable procedures and diagrams, and discussions with the applicant, the staff determined that the screening methodology for mechanical systems was adequately implemented.

2.1.3.2.2 Structural Component Screening

Following identification of the SSCs within the scope of license renewal, the staff reviewed the applicant's screening review, in accordance with ES-705 and TR00170-002, to determine which structural components would be subject to an AMR in accordance with 10 CFR 54.21(a)(1). An AMR of a structural component is required if the component performs an intended function without moving parts or without a change in configuration or properties (i.e., passive) and if it is not subject to replacement on the basis of a qualified life or specified time period (i.e., long-lived). The applicant used industry experience and NEI 95-10 to develop a master list of component types and potential intended functions. The applicant established the structure evaluation boundaries, identified structural component types, including long-lived passive components within the evaluation boundaries, and identified potential and actual structural component intended functions and components subject to an AMR. The staff reviewed the methodology used by the applicant to identify and list the structural components and structural commodities subject to an AMR, as well as the applicant's technical justification for this methodology. The staff reviewed a sample of plant structures (auxiliary building and turbine building) identified as being within the scope, including the evaluation boundaries and resultant components, the corresponding component level intended functions, and the resulting list of structural components and structural commodity groups subject to an AMR. The staff also reviewed a sample of the structural drawing packages assembled by the applicant and discussed the process and results with the cognizant engineers who performed the review. The staff did not identify any discrepancies between the methodology documented and the implementation results.

2.1.3.2.3 Electrical and Instrumentation and Control Component Screening

After identifying the SSCs within the scope of license renewal, the staff reviewed the applicant's screening review to determine which electrical components would be subject to an AMR. As part of this effort, the applicant relied on the requirements set forth in 10 CFR 54.21(a)(1)(i) as supplemented by industry guidance in NEI 95-10 to develop a commodity evaluation approach based on a plant-level evaluation of electrical equipment. The applicant reviewed the component to determine whether the component was passive and long-lived.

The process began with a list of generic electrical commodities from Appendix B to NEI 95-10. Next the applicant applied passive screening that eliminated from the list all commodities that were active rather than passive (i.e.,components that performed an intended function without moving parts or without a change in configuration). The applicant applied long-lived screening to components that were to be replaced based on a qualified life and removed them from the license renewal scope. The remaining passive commodities included non-EQ insulated cables,

connectors, splices, penetration assemblies and terminal blocks, and high voltage electrical switchyard busses, transmission conductors, connections, and insulators. The applicant also indicated that non-EQ fused blocks would be added to this group based upon the guidance in the corresponding NRC ISG. The applicant concluded that all electrical components included in the applicant's EQ program were short-lived and were screened out of license renewal scope. The staff also reviewed the methodology used by the applicant to identify and list the electrical components and commodities subject to an AMR, as well as the applicant's technical justification for this methodology, and discussed the methodology and results with the applicant's LRA staff. The staff also sampled several engineering analyses to verify implementation of the screening process for electrical and I&C components. Based on the above, the staff determined that the screening methodology for electrical and I&C components was adequately implemented.

2.1.4 Conclusions

The basis of the staff's safety determination included the review of the information presented in Section 2.1 of the LRA, the supporting information in the VCSNS UFSAR, the information presented during the staff's scoping and screening audit, NRC scoping and AMR inspections, and the applicant's responses to the staff's RAIs. The staff verified that the applicant's scoping and screening methodology, including their supplemental 10 CFR 54.4(a)(2) review, which brought additional non-safety-related piping segments and associated components into scope, was consistent with the requirements of the Rule and the staff's position on the treatment of non-safety-related SSCs. On the basis of this review, the staff finds that the applicant's methodology for identifying SSCs within the scope of license renewal, and the SCs requiring an AMR, is consistent with the requirements of 10 CFR 54.4 and 10 CFR 54.21(a)(1).

2.1.5 References

1. NUREG-1800, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants," April 2001

2. NEI 95-10, "Industry Guideline for Implementing the Requirements of 10 CFR Part 54 - The License Renewal Rule, Revision 3," August 2001

3. NUREG-1801, "Generic Aging Lessons Learned Report (GALL)," April 2001

4. NRC Inspection Report No. 50-395/03-07 for the V.C. Summer Nuclear Station, dated June 13, 2003.

5. Letter from USNRC to SCE&G, "Request for Additional Information for the Review of the V.C. Summer Nuclear Station License Renewal Application," dated March 28, 2003.

6. Letter from SCE&G to USNRC, "Responses to Request for Additional Information for the Review of the License Renewal Application for the Virgil C. Summer Nuclear Station," dated June 16, 2003 (RC-03-0112).

7. ES-411, "Equipment Classifications," Revision 9.

8. ES-412, Attachment 1, "Appendix R Evaluation Phase II Composite Equipment List," dated September 30, 1998.

9. ES-427, "Program/Issue Screening," Revision 1.

10. ES-701, "Mechanical System Scoping for License Renewal," Revision 1, dated July 31, 2000.

11. ES-702, "Mechanical Component Screening for License Renewal," Revision 1, dated July 31, 2000.

12. ES-703, "Mechanical Component Aging Management Review for License Renewal," Revision 2, dated July 8, 2002.

13. ES-704, "Electrical Systems Scoping, Screening, and Aging Management Review," Revision 2, dated February 5, 2002.

14. ES-705, "Civil/Structural Scoping, Screening, and Aging Management Review for License Renewal," Revision 2, dated September 24, 2001.

15. ES-706, "Identification and Evaluation of Time Limited Aging Analyses and Exemptions for License Renewal," Revision 2.

16. DBD, "Feedwater System," Revision 8, dated August 27, 2002.

17. DBD, "Component Cooling Water System," Revision 10, dated September 28, 2002.

18. DBD, "Emergency Feedwater System," Revision 11, dated August 28, 2001.

19. DBD, "Safety Injection System," Revision 10, dated November 17, 1999.

20. TR00150-001, "Electrical Systems Scoping for License Renewal, Revision 0, dated July 3, 2002."

21. TR00150-002, "Electrical Screening for License Renewal, Revision 0, dated July 3, 2002."

22. TR00150-003, "Electrical Component Aging Management Review for License Renewal," Revision 0, dated July 3, 2002.

23. TR00160-001, "Mechanical Systems Scoping for License Renewal," Revision 0, dated July 3, 2002.

24. TR00160-003, "Mechanical Component Screening for License Renewal (Treated Water Systems,“ Revision 0.

25. TR00160-013, "Mechanical Component Aging Management Review for License Renewal (Treated Water Systems),“ Revision 0.

26. TR00160-018, "Refined 10 CFR Part 54.4(a)(2) Criteria Evaluations for License Renewal," Revision 0, dated September 6, 2002.

27. TR00170-001, "Structural Scoping for License Renewal, Revision 0, dated July 3, 2002."

28. TR00170-002, "Structures Screening for License Renewal, Revision 0, dated July 3, 2002."

29. TR00170-003, "Structures Aging Management Review for License Renewal," Revision 0, dated July 3, 2002.

30. SAP-605, "Application of CHAMPS."

31. SAP-630, "Procedure/Commitment Accountability Program," Revision 6.

32. SAP-1041, "Statement of Responsibilities, Plant Life Extension," Revision 0, dated November 11, 2002.

33. Duke Engineering & Services Task No. 7A, 8, 9, 10, 11& 12, "Project Execution Plan," Revision 0, TM/W 210-01, "Plant License Renewal Fundamentals."

34. Memorandum, "Self-Assessment Report for the License Renewal Project," dated May 24, 2002.

35. Report SA02-PX-02, "License Renewal Self Assessment Report - Aging Management Programs," dated November 11, 2002.

36. TR Package No. 2, "Fire Protection," Revision 8.

37. EQ Report No. 984, "Equipment Qualified to a Harsh Environment - Master Equipment List," dated November 13, 2002.

38. QA-SUR-200119-0, "Plant Life Extension," dated October 16, 2001.

39. P&ID D-302-083, "Feedwater," Revision 47.

40. P&ID D-302-085, "Emergency Feedwater," Revision 40.

41. P&IDs E-302-691, 692, and 693.

42. Drawing D-302-661, "Reactor Building Containment Spray System."

43. Drawing D-302-651, "Spent Fuel Pool Cooling."

44. Drawings D-302-611, 612, and 613, "Component Cooling System," and D-302-614, "Component Cooling System To NSSS Pumps."

45. Drawings D-302-231, Sheets 1 thru 5.

46. Drawing E-302-641, "Residual Heat Removal System."

47. Gilbert Commonwealth Drawing B-817-026.

2.2 Plant Level Scoping Results

2.2.1 Introduction

The statements of consideration (SOC) for the License Renewal Rule (*Federal Register*, Volume 60, No. 22478) indicate that an applicant has the flexibility to determine the set of SSCs for which an AMR is performed. In LRA Section 2.1.1, the applicant described the methodology for identifying the SSCs within the scope of license renewal. In LRA Section 2.2, the applicant uses the scoping methodology to determine which of the SSCs are required or not required to be included in the scope of license renewal. The staff reviewed the plant level scoping results to determine whether the applicant has properly identified all plant level SSCs that are relied upon to mitigate DBEs, as required by 10 CFR 54.4(a)(1), or whose failure could prevent satisfactory accomplishment of any of the safety-related functions, as required by 10 CFR 54.4(a)(2), as well as the SSCs relied on in safety analysis or plant evaluations to perform a function that is required by one of the regulations referenced in 10 CFR 54.4(a)(3).

The staff reviewed the SSCs that the applicant did not identify as being within the scope of license renewal to verify whether they have any intended functions that are within the scope of license renewal. The staff also reviewed the selected SSCs that the applicant has identified as being within the scope of license renewal to verify whether the applicant properly identified their components within the evaluation boundary that are subject to an AMR, in accordance with the requirements of 10 CFR 54.21(a)(1). To determine whether the applicant identified the SSCs that are subject to an AMR, the staff reviewed the components that the applicant had not identified as being subject to an AMR.

2.2.2 Summary of Technical Information in the Application

This section addresses the plant level scoping results for the license renewal. Pursuant to 10 CFR 54.21(a)(1) the applicant is required to identify and list SCs subject to an AMR. These are the passive and long-lived SCs that are within the scope of license renewal.

In LRA Table 2.2-1, the applicant lists plant level scoping results for mechanical systems, which includes all the mechanical systems both in scope and not in scope. The plant level scoping results for structures are listed in LRA Table 2.2-2, which include all the structures and buildings both in scope and not in scope. The specific mechanical systems within the scope of license renewal are described in detail in LRA Section 2.3. The specific structures and buildings within the scope of license renewal are described in detail in LRA Section 2.4. The electrical and I&C systems that support the operation of both safety- and non-safety-related systems and components are described in LRA Section 2.5. In the LRA, the electrical and I&C components are treated as commodities. In scoping the electrical systems, only the electrical commodity groups that perform a passive safety function are subject to an AMR. To verify whether the applicant has properly implemented its methodology, the staff focused its review on the implementation results to confirm that there is no omission of plant level systems and structures within the scope of license renewal.

2.2.2.1 Systems, Structures, and Components Within the Scope of License Renewal

In LRA Sections 2.2 through 2.5, the applicant describes the SSCs that are within the scope of license renewal, and subject to an AMR, in accordance with the requirements of 10 CFR 54.4(a) and 10 CFR 54.21(a)(1), respectively. As described in LRA Section 2.1, "Scoping and Screening Methodology," the scoping and screening of mechanical components were performed using the plant's DBDs, component databases, and flow diagrams (P&ID drawings). The applicant uses two controlled databases to perform the scoping and screening — component history and maintenance planning (CHAMPS) database and equipment qualification database (EQDB). The CHAMPS is a controlled database that contains as-built information on a component level that consists of multiple data field for each component. The EQDB is a controlled database that consists of multiple data fields for each component or subcomponent, including component identification, maintenance requirements, etc. The two databases uniquely identify most of the mechanical components at the plant and provide links to the associated systems. The applicant also identified those mechanical components in the databases not assigned with unique component numbers by evaluating design drawings and documents, and also by plant walkdowns. The items in the databases were treated as commodities for the purposes of license renewal.

LRA Table 2.2-1 provides the results of the applicant's plant-wide scoping of the mechanical systems. The table identifies which of the plant systems are within the scope of license renewal and which of them are not. The table also indicates whether the intended functions of a given system is needed to satisfactorily accomplish any of the functions identified in 10 CFR 54.4 (a)(1), (a)(2), and (a)(3). The LRA considers electrical and I&C systems as generic and treated them as groups of commodities. The scoping results for the commodity groups of electrical and I&C components are listed in LRA Table 2.2-3.

Plant structures that satisfy one or more of the criteria in 10 CFR 54.4, and contain in-scope mechanical and electrical components, are within the scope of license renewal and subject to an AMR. All seismic Class I SCs are considered safety-related and are in scope. Non-safety-related SSCs whose failure could prevent satisfactory accomplishment of any of the functions identified in 10 CFR 54.4(a)(1), (2), and (3) are within the scope of license renewal. The applicant also evaluated the non-safety-related systems that may have spatial relationships with safety-related components such that their failure could adversely impact the performance of an intended safety function (related to seismic II/I issues). The applicant documented the seismic II/I evaluations in a technical report (i.e., RC-02-0159). The staff's review of the technical report is addressed in Section 2.3.5 of this SER.

2.2.2.2 Systems and Structures Not Within the Scope of License Renewal

In addition to the SSCs in scope, LRA Table 2.2-1 contains 54 mechanical systems that are not within the scope of license renewal. Also, LRA Table 2.2-2 lists 67 structures or buildings and LRA Table 2.2-3 lists 16 electrical systems that are not within the scope of license renewal. However, these tables do not provide reasons why the SSCs are not in scope (this is discussed in Section 2.2.3 of this SER).

2.2.3 Staff Evaluation

The staff reviewed LRA Section 2.2 and Tables 2.2-1, 2.2-2, and 2.2-3 to determine whether the applicant has properly identified all plant level SSCs that are within the scope of license renewal, as required by 10 CFR 54.4. The staff's review was conducted in accordance with Section 2.2 of the SRP-LR NUREG-1800 and is described as follows.

In LRA Section 2.1, the applicant describes the process for identifying the SSCs that are within the scope of license renewal and subject to an AMR. This methodology typically consists of a review of all plant level SSCs to identify those that are within the scope of license renewal in accordance with the requirements of 10 CFR 54.4. From those in-scope SSCs, the applicant identifies and lists their components that are passive (that perform their intended functions without moving parts, or without a change in configuration or properties), and are long-lived (that are not replaced based on a qualified life or specified time period). The staff reviewed the scoping and screening methodology and provided its evaluation in Section 2.1 of this SER. The applicant documented its implementation of the methodology in LRA Sections 2.3 through 2.5. The staff's evaluation of the applicant's implementation is addressed in Sections 2.3 through 2.5 of this SER.

The staff reviewed LRA Section 2.1 to ensure that the scoping and screening methodologies described in the section were properly implemented, and that the components that are subject to an AMR were properly identified. The staff also reviewed LRA Section 2.2 and sampled the contents of VCSNS UFSAR, based on the listing of systems and structures in LRA Tables 2.2-1 and 2.2-2, to determine whether there were systems or structures that may have intended functions, as identified by 10 CFR 54.4, but were not included in the scope of license renewal.

During its review of LRA Section 2.2 and LRA Tables 2.2-1 and 2.2-2, the staff determined that additional information and/or clarification was needed to complete its review. Because the applicant did not justify the mechanical systems and structures in the LRA tables not in scope, the staff was unable to determine whether some of these mechanical systems (in Table 2.2-1) and plant structures (in Table 2.2-2) are required to be in scope. By letter dated March 28, 2003, in RAI 2.2.2-1, the staff requested the applicant to explain why the following mechanical systems and plant structures are not within the scope of license renewal:

- emergency offsite facility (EO)
- emergency equipment (EQ)
- liquid effluent from nuclear plant to pen stock (LW)
- radwaste solidification and solids handling (WD)
- auxiliary fire pump house
- containment access building (CAB)
- lighting masts (plant)
- radiological maintenance building

In its response, dated June 12, 2003, the applicant provided the following clarification or justification for the above systems and structures not in scope:

- The EO is for emergency plan activities and has no direct license renewal function. Loss of system function will not result in the loss of any safety related functions.

- The EQ system is inactive.

- The LW was not initially included in the license renewal scope. As a result of the Criterion 2 reassessment, this non-safety-related system was added to the scope of license renewal due to its potential spatial interactions with safety-related components. The Criterion 2 supplement to the LRA was submitted to the NRC separately in a technical report (RC-02-0159) dated September 12, 2002.

- The WD was not initially included in the license renewal scope. As a result of the Criterion 2 reassessment, this non-safety-related system was added to the scope of license renewal due to its potential spatial interactions with safety-related components.

- The auxiliary fire pump house is a structure that houses the auxiliary backup fire pumps used during construction. There are no mechanical or electrical components in the structure that are within the scope of license renewal.

- The CAB was constructed to facilitate containment access during the steam generator replacement project and no longer serves a direct plant operational or access function. It is used for storage in the radiological maintenance area and performs no intended function for license renewal.

- The plant lighting masts are the high light pole structures located around the plant site. They are not used to support any of the regulated events and perform no intended functions for license renewal.

- The radiological maintenance building serves as a maintenance facility for contaminated components and tools and performs no intended functions for license renewal.

The staff reviewed the applicant's response and concurs with its decision to include the LW system and WD system in the scope of license renewal based on Criterion 2 reevaluation. The staff's review of the Criterion 2 Supplement is addressed in Section 2.3.5 of this SER. The staff also agreed with the applicant's rationale for not requiring the remaining mechanical systems and structures to be in scope, except plant lighting masts. The staff considered that the plant lighting masts have an intended function to support plant lighting. Failure of lighting pole structures may cause blackout of the plant site. Therefore, the light poles should be included in the yard structures for license renewal. In a letter, dated June 12, 2003, the applicant further explained that the high mast lighting poles should not be in scope. The applicant stated that there are seven high mast light poles located around the plant site that serve as security lighting. These high mast light poles are not used to support accident conditions or any of the regulated events and thus perform no intended functions for license renewal. In addition to these high mast light poles, exterior lighting also consists of standard height light poles and wall-mounted lights along the perimeter of each structure within the protected area of the plant. All of the exterior lighting is supplied by 480-volt, single phase power from the nearest available

480-volt load center. Because none of the exterior lights are credited for accident or any event described in 10 CFR 54.4(a)(3), the plant lighting masts are not considered to be in the scope of license renewal.

The staff reviewed the applicant's response and found its rationale acceptable because the plant site has provided redundant lighting supplied from offsite power. The plant lighting masts are not required to support plant lighting and, therefore, can be excluded from the license renewal scope. On the basis of this review, the staff did not identify any omissions.

2.2.4 Conclusions

The staff reviewed LRA Sections 2.2.1 and 2.2.2, supporting information in the plant's UFSAR, and the information provided in response to the staff's RAI to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. As a result of this review, the staff did not identify any omissions. On the basis of this review, the staff concludes that the applicant has appropriately identified the SSCs that are within the scope of license renewal, in accordance with the requirements of 10 CFR 54.4. The staff's detailed review of the SSCs that are subject to an AMR is provided in Section 2.3 through 2.5 of this SER.

2.2.5 References

1. 10 CFR 54, Requirements for Renewal of Operating License for Nuclear Power Plants, 60 FR 22461, May 8, 1995.

2. NEI 95-10 (Revision 3), Industry Guideline for Implementing the Requirements of 10 CFR Part 54—The License Renewal Rule, August 2001.

3. VCSNS Final Safety Analysis Report (FSAR), Amendment 02–1.

4. NUREG-1800, Standard Review Plan for the Review of License Renewal Application for Nuclear Power Plants, July 2001.

5. Generic Aging Lessons Learns (GALL) Report, July 2001

2.3 Scoping and Screening Results: Mechanical Systems

Pursuant 10 CFR 54.21(a)(1) an applicant is required to identify and list SCs subject to an AMR. These are passive, long-lived SCs that are within the scope of license renewal. To verify that the applicant has properly implemented the scoping and screening methodology, the staff focuses its review on the implementation results. Such a focus allows the staff to confirm that the LRA has identified all the mechanical system components that would be subject to an AMR.

2.3.1 Reactor Vessel, Internals and Reactor Coolant System

The reactor coolant system components consist of the reactor vessel, reactor vessel internals, incore instrumentation system, pressurizer, steam generators, and associated reactor coolant system piping.

2.3.1.1 Reactor Coolant System

The applicant describes the reactor coolant system in LRA Section 2.3.1.1. The mechanical component types and component intended functions for the reactor coolant system components are listed in Table 2.3-1. Additional information about the reactor coolant system can be found in UFSAR Chapter 5.

2.3.1.1.1 Summary of Technical Information in the Application

The reactor coolant system consists of three heat transfer loops connected in parallel to the reactor vessel. Each loop contains one steam generator, one reactor coolant pump, connecting piping, and instrumentation. The reactor coolant system is designed to remove heat from the reactor core and transfer it to the secondary (steam generating) system by the forced circulation of pressurized water that serves both as a coolant and a neutron moderator. The design pressure and temperature are 2500 psi and 650 °F, respectively.

A pressurizer is connected to one of the reactor vessel outlet (hot leg) pipes by a surge line. The pressurizer controls and maintains reactor coolant system pressure. The pressurizer contains steam and water, which are maintained in thermal equilibrium. Immersion heaters in the pressurizer are energized to form steam, and subcooled water is sprayed into the pressurizer steam space to condense steam. In this way, the pressurizer is used to maintain operating pressure and limit pressure variations due to plant load transients. Overpressure protection for the system is provided by three power-operated relief valves and three spring-loaded ASME Code safety valves. These valves discharge to the pressurizer relief tank where the steam is released under water to be condensed and cooled. If the steam discharge exceeds the capacity of the tank, the tank's rupture disks open, at about 100 psi, and allow steam to exit into the containment atmosphere.

All components of the reactor coolant system are located within the containment building. The reactor coolant system boundary is defined to include all the components in the reactor coolant system except the reactor vessel and head. The main reactor coolant system components include the reactor coolant pumps and motors, reactor coolant piping, pressurizer, pressurizer heaters, power-operated relief valves and safety valves, steam generators, and associated instrumentation and controls. The scoping and screening results for the pressurizer are discussed in Section 2.3.1.6 of this report.

The steam generator boundaries are set at the ends of the nozzles connecting the steam generators to other components or systems. The nozzles include main feedwater, auxiliary feedwater, steam, reactor coolant system inlet and outlet, and instrumentation. The scoping and screening results for the steam generators are discussed in Section 2.3.1.7 of this report.

The major system interfaces with the reactor coolant system are the chemical and volume control system, safety injection system, and the reactor vessel.

The non-Class 1 reactor coolant system component types subject to AMR and their intended functions, listed in Table 2.3-1 of the LRA, include the reactor coolant pump oil collection system and oil cooler heat exchanger, various orifices, piping and tanks, valves (body only), tubes and tube fittings, and flanges. The intended functions identified for these RC components were pressure boundary, throttling, and fire protection.

2.3.1.1.2 Staff Evaluation

The staff reviewed Section 2.3.1.1 of the LRA and Chapter 5 of the UFSAR to determine whether the reactor coolant system and associated components and supporting structures within the scope of license renewal and subject to AMR had been identified in accordance with the requirements of 10 CFR 54.4 and 10 CFR 54.21(a)(1), respectively. The staff review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

As part of the evaluation, the staff determined whether the applicant had properly identified the SSCs within the scope of license renewal and subject to an AMR, pursuant to 10 CFR 54.4(a) and 10 CFR 54.21(a)(1). The staff reviewed Chapter 5 of the UFSAR for VCSNS for the reactor coolant system and associated components and compared the information in the UFSAR with the information in the LRA to identify those portions that the LRA did not identify as being within the scope of license renewal and subject to an AMR. The staff then reviewed the SCs that were identified as not being within the scope of license renewal to verify that these SCs do not have any of the intended functions delineated under 10 CFR 54.4(a), and for those SCs that have an applicable intended function(s), to verify that they either perform this function(s) with moving parts or a change in configuration or properties, or that they are subject to replacement based on a qualified life or specified time period, as described in 10 CFR 54.21(a)(1).

The staff also reviewed the UFSAR for any function(s) delineated under 10 CFR 54.4(a) that were not identified as intended function(s) in the LRA, to verify that the SSCs with such function(s) will be adequately managed so that the function(s) will be maintained consistent with the CLB for the period of extended operation.

Since the reactor coolant system piping is largely composed of components that form the pressure boundary, and that carry the reactor coolant to the reactor vessel and the steam generators, the staff's review was centered upon identification of the components that perform the functions described in 10 CFR 54.4(a)(1). The staff's review of long-lived, passive components in the reactor coolant system has identified, and excluded, those components that are periodically replaced, such as seals and gaskets, and active components, such as the moving parts in pumps and valves.

Non-safety related components and piping were also considered (1) if they could fail in such a manner as to prevent other SCs from completing any of the functions described in 10 CFR 54.4(a)(1), or (2) if they are required for compliance with the regulations for fire protection, EQ, PTS protection, ATWS protection, or SBO protection, as listed in 10 CFR 54.4(a)(3).

The applicant has not included the pressurizer relief tank in the pressure-retaining boundary. The pressure-retaining boundary of the pressurizer relief tank will be maintained only until the tank's rupture disks give way, as designed, at about 100 psid. Basically, the pressurizer relief tank could not be considered to be part of the pressure-retaining boundary since its rupture disks are not designed to withstand pressure levels exceeding about 100 psi. The pressurizer relief and safety valves are the components that protect the pressure-retaining boundary, whereas the pressurizer relief tank serves as a coolant discharge collection device that is situated downstream of the pressurizer relief and safety valves. The applicant's categorization

of the pressurizer relief tank, as being outside the scope of license renewal, is acceptable to the staff.

No omissions of SSCs that are within the scope of license renewal and subject to an AMR were found.

2.3.1.1.3 Conclusions

The staff reviewed Section 2.3.1.1 of the LRA and Chapter 5 of the UFSAR to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. No omissions were found. On the basis of its review, the staff concludes that the applicant has adequately identified the reactor coolant system components that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has adequately identified the reactor coolant system components that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.1.2 Piping, Valves and Pumps

The applicant describes the piping, valves, and pumps in LRA Section 2.3.1.2. The mechanical component types and component intended functions for the reactor coolant system Class 1 piping and associated pressure boundary components are listed in Table 2.3-2. UFSAR Section 5.5, Component and Subsystem Design, provides additional information concerning Class 1 piping and associated pressure boundary components.

2.3.1.2.1 Summary of Technical Information in the Application

The reactor coolant system Class 1 piping and associated pressure boundary components consist of the following:

- primary loop piping interconnecting the reactor vessel, steam generators and reactor coolant pumps

- the piping (including fittings, branch connections, safe ends, thermal sleeves, flow restrictors, and thermowells) and valves leading to connecting auxiliary or support systems, up to and including the second isolation valve (from the high pressure side) on each line

- pressure boundary portion of Class 1 valves (body, bonnet, and bolting)

- pressure boundary portion of the reactor coolant pumps (casing, main closure flange, thermal barrier heat exchanger and bolting)

The primary loop piping consists of three closed reactor coolant loops interconnecting the reactor vessel, steam generators, and reactor coolant pumps. Class 1 branch piping consists of piping connected to the Class 1 primary loop piping out to and including the outermost containment isolation valve in piping which penetrates primary containment, or the second of two valves normally closed during normal reactor operation in piping which does not penetrate primary containment. Some Class 1 branch lines and instrument lines are equipped with

3/8-inch inside diameter flow restrictors. These flow restrictors limit the maximum flow from a break downstream of the flow restrictor to below the makeup capability of the charging system.

The pressure retaining portion of the Class 1 valves includes the body, bonnet, and bolting. The valves are welded into the piping, except for the pressurizer relief and pressurizer code safety valves, which have flanged connections. The portions of the reactor coolant pumps that perform a pressure boundary function are the pump casing, main closure flange, thermal barrier heat exchanger, and bolting. The reactor coolant pumps are vertical, single stage, centrifugal pumps, equipped with controlled leakage shaft seals. The shaft seals are excluded from AMR because they are periodically replaced.

The Class 1 portion of the reactor coolant system includes portions of the chemical and volume control system, emergency core cooling system, residual heat removal system, and safety injection system.

The component types subject to AMR and their intended functions, listed in Table 2.3-2 of the LRA, include reactor coolant pump main flange bolting materials, reactor coolant pump thermal barrier flange, main closure flange, reactor coolant pump thermal barrier piping/tubing (less than 4-inches normal pipe size (NPS), and reactor coolant pump casing. The intended functions identified for these components were pressure boundary and throttling.

2.3.1.2.2 Staff Evaluation

The staff reviewed LRA Section 2.3.1.2 and UFSAR Section 5.5 to determine whether the piping, valves and pumps and supporting structures within the scope of license renewal and subject to an AMR had been identified in accordance with the requirements of 10 CFR 54.4 and 10 CFR 54.21(a)(1), respectively. The staff review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

As part of the evaluation, the staff determined whether the applicant had properly identified the SSCs within the scope of license renewal and subject to an AMR, pursuant to 10 CFR 54.4(a) and 10 CFR 54.21(a)(1). The staff reviewed the relevant portions of the UFSAR for VCSNS for the piping, valves, and pumps and associated pressure boundary components, and compared the information in the UFSAR with the information in the LRA to identify those portions that the LRA did not identify as being within the scope of license renewal and subject to an AMR. The staff then reviewed the SCs that were identified as not being within the scope of license renewal to verify that these SCs do not have any of the intended functions delineated under 10 CFR 54.4(a), and for those SCs that have an applicable intended function(s), to verify that they either perform this function(s) with moving parts or a change in configuration or properties, or that they are subject to replacement based on a qualified life or specified time period, as described in 10 CFR 54.21(a)(1).

The staff also reviewed the UFSAR for any functions delineated under 10 CFR 54.4(a) that were not identified as intended functions in the LRA, to verify that the SSCs with such functions will be adequately managed so that the functions will be maintained consistent with the CLB for the period of extended operation.

No omissions of SSCs that are within the scope of license renewal and subject to an AMR were found.

2.3.1.2.3 Conclusions

The staff reviewed LRA Section 2.3.1.2 and UFSAR Section 5.5 to determine whether any piping, valves, and pumps within the scope of license renewal had not been identified by the applicant. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. On the basis of its review, the staff concludes that the applicant has adequately identified the piping, valve and pump components that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has adequately identified the reactor coolant system components that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.1.3 Reactor Vessel

The applicant describes the reactor vessel in LRA Section 2.3.1.3 and provides a list of components that would be subject to an AMR in LRA Table 2.3.1.3-1. More information about the reactor vessel can be found in UFSAR Section 5.4.

2.3.1.3.1 Summary of Technical Information in the Application

The reactor vessel is a three-loop vessel, with three coolant inlet nozzles and three coolant outlet nozzles. The reactor vessel is cylindrical, with a welded hemispherical bottom head and a removable, bolted, flanged, and gasketed hemispherical upper head.

The vessel contains the core, core support structures, control rods, and other parts directly associated with the core. The reactor vessel closure head contains head adaptors. These head adaptors are tubular members, attached by partial penetration welds to the underside of the closure head. The upper end of these adaptors contain acme threads for the assembly of control rod drive mechanisms or instrumentation adaptors. The seal arrangement at the upper end of these adaptors consists of a welded flexible canopy seal. Inlet and outlet nozzles are located symmetrically around the vessel.

The bottom head of the vessel contains penetration nozzles for connection and entry of the nuclear incore instrumentation. Each nozzle consists of a tubular member made of Inconel. Each tube is attached to the inside of the bottom head by a partial penetration weld. The nuclear incore instrumentation system is discussed in Section 2.3.1.5 of this report.

The major system interfaces with the reactor vessel are the reactor coolant system, nuclear incore instrumentation system, and the reactor vessel internals.

The list of reactor vessel component types subject to AMR and their intended functions, shown in Table 2.3-3 of the LRA, includes the reactor vessel shell, ventilation shroud, inlet and outlet nozzles, core support pads, closure head and flanges, cladding, closure head dome and lifting lugs, nozzle supports, bottom head dome, control rod drive mechanism latch housing and rod travel housing, and bottom head penetration tubes. All of the SSCs were identified as being within the scope of license renewal and subject to an AMR because they were part of the pressure-retaining boundary.

2.3.1.3.2 Staff Evaluation

The staff reviewed LRA Section 2.3.1.3 and UFSAR Section 5.4 to determine whether the reactor vessel and supporting structures within the scope of license renewal and subject to an AMR had been identified in accordance with the requirements of 10 CFR 54.4 and 10 CFR 54.21(a)(1), respectively. The staff review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

As part of the evaluation, the staff determined whether the applicant had properly identified the SSCs within the scope of license renewal and subject to an AMR, pursuant to 10 CFR 54.4(a) and 10 CFR 54.21(a)(1). The staff reviewed the relevant portions of the UFSAR for VCSNS for the reactor vessel and associated pressure boundary components and compared the information in the UFSAR with the information in the LRA to identify those portions that the LRA did not identify as being within the scope of license renewal and subject to an AMR. The staff then reviewed the SCs that were identified as not being within the scope of license renewal to verify that these SCs do not have any of the intended functions delineated under 10 CFR 54.4(a), and for those SCs that have an applicable intended function(s), to verify that they either perform this function(s) with moving parts or a change in configuration or properties, or that they are subject to replacement based on a qualified life or specified time period, as described in 10 CFR 54.21(a)(1).

The staff also reviewed the UFSAR for any functions delineated under 10 CFR 54.4(a) that were not identified as intended functions in the LRA, to verify that the SSCs with such functions will be adequately managed so that the functions will be maintained consistent with the CLB for the period of extended operation.

The reactor vessel is the epitome of the class of passive, long-lived components that are within the scope of license renewal. It is the key Class 1 component in the pressure-retaining boundary, since it enables proper cooling of the core under normal and accident conditions. Therefore, the staff's review of the reactor vessel, and its constituent components, as listed in Table 2.3-3, has been mainly with respect to the requirements of 10 CFR 54.4(a). Since all the components were in the pressure-retaining boundary, the review also focused upon the variety of penetrations in the upper and lower vessel heads.

No omissions of SSCs that are within the scope of license renewal and subject to an AMR were found.

2.3.1.3.3 Conclusions

The staff reviewed LRA Section 2.3.1.3 and UFSAR Section 5.4 to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. No omissions were found during the independent assessment. On the basis of its review, the staff concludes that the applicant has adequately identified the reactor vessel components that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has adequately identified the reactor vessel components that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.1.4 Reactor Vessel Internals

The applicant describes the reactor vessel internals in LRA Section 2.3.1.4 and provides a list of components subject to an AMR in LRA Table 2.3-4. UFSAR Section 4.2.2, Reactor Vessel Internals, provides additional information concerning the reactor vessel internals.

2.3.1.4.1 Summary of Technical Information in the Application

The components of the reactor internals are divided into three parts consisting of the lower core support structure (including the entire core barrel and neutron shield pad assembly), the upper core support structure. and the incore instrumentation support structure. The reactor internals support the core, maintain fuel alignment, limit fuel assembly movement, maintain alignment between fuel assemblies and control rod drive mechanisms, direct coolant flow past the fuel elements, direct coolant flow to the pressure vessel head, provide gamma and neutron shielding, and provide guides for the incore instrumentation.

The coolant flows from the vessel inlet nozzles, down the annulus between the core barrel and the vessel wall, and into a plenum at the bottom of the vessel. The coolant then reverses direction and flows up through the core support and lower core plates. After passing through the core, the coolant enters the region of the upper support structure and then flows radially to the core barrel outlet nozzles and directly through the vessel outlet nozzles.

All reactor vessel Internals components are considered Class 1 for seismic design. The effects of neutron embrittlement on materials utilized and accident loadings on the internals have been considered in the design analysis.

The license renewal boundary for the reactor vessel internals consists of all components internal to the reactor vessel, excluding the reactor vessel and head, the control rod drive mechanisms, (CRDMs) and integral attachments to the reactor vessel and head.

The components of the reactor vessel internals, subject to AMR, include the following major components and their associated subcomponents:

- baffle and former assembly
- bottom mounted instrumentation columns
- clevis inserts
- core barrel and flange
- core barrel outlet nozzle
- guide tube
- lower core plate
- lower support columns
- lower support plate
- neutron panels
- radial keys
- spray nozzle
- upper core plate
- upper instrumentation conduit and supports
- upper support column
- upper support plate assembly

The intended functions identified for the reactor vessel internals components were structure functional support, flow distribution, control rod guidance and protection, and radiation shielding.

2.3.1.4.2 Staff Evaluation

The staff reviewed LRA Section 2.3.1.4 and UFSAR Section 4.2.2, Reactor Vessel Internals, to determine whether the reactor vessel internals and supporting structures within the scope of license renewal, and subject to an AMR had been identified in accordance with the requirements of 10 CFR 54.4 and 10 CFR 54.21(a)(1), respectively. The staff review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

As part of the evaluation, the staff determined whether the applicant had properly identified the SSCs within the scope of license renewal and subject to an AMR, pursuant to 10 CFR 54.4(a) and 10 CFR 54.21(a)(1). The staff reviewed the relevant portions of the UFSAR for the reactor vessel internals and associated pressure boundary components and compared the information in the UFSAR with the information in the LRA to identify those portions that the LRA did not identify as being within the scope of license renewal and subject to an AMR. The staff then reviewed the SCs that were identified as not being within the scope of license renewal to verify that these SCs do not have any of the intended functions delineated under 10 CFR 54.4(a), and for those SCs that have an applicable intended function(s), to verify that they either perform this function(s) with moving parts or a change in configuration or properties, or that they are subject to replacement based on a qualified life or specified time period, as described in 10 CFR 54.21(a)(1).

The staff also reviewed the UFSAR for any function(s) delineated under 10 CFR 54.4(a) that were not identified as intended function(s) in the LRA, to verify that the SSCs with such function(s) will be adequately managed so that the function(s) will be maintained consistent with the CLB for the period of extended operation.

Many of the reactor vessel internals are identified as components that provide structural support to safety-related components. They can provide, for example, the structural support needed to maintain a coolable core geometry during a design basis loss of coolant accident (LOCA). Unlike many other long-lived, passive components, certain reactor internals are normally moved (i.e., removed and set aside) to permit the movement of fuel assemblies during refueling. This provides occasional opportunities to detect and remedy aging-related problems that might affect these reactor vessel internals. Although these particular components would have the benefit of periodic examination, they would still be included in the license renewal scope and subject to aging management requirements.

No omissions of SSCs that are within the scope of license renewal and subject to an AMR were found.

2.3.1.4.3 Conclusions

The staff reviewed the information presented in Section 2.3.1.4 of the LRA and the supporting information in UFSAR Section 4.2.2, Reactor Vessel Internals, to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. In addition, the

staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. No omissions were found. On this basis, the staff concludes that the applicant has adequately identified the reactor vessel internals components that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has adequately identified the reactor vessel internals components that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.1.5 Incore Instrumentation System

The applicant describes the incore instrumentation system in LRA Section 2.3.1.5 and provides a list of components subject to an AMR, along with their component intended functions, in LRA Table 2.3-5. The components are depicted in 1MS-44-014, "3-Loop Plant Bottom Mounted Inst. Standard Layout." UFSAR Section 4.4.5.1, Incore Instrumentation, provides additional information concerning the incore instrumentation system.

2.3.1.5.1 Summary of Technical Information in the Application

The incore instrumentation system is comprised of thermocouples positioned to measure fuel assembly coolant outlet temperatures at pre-selected positions, and fission chamber detectors positioned in guide thimbles, which run the length of selected fuel assemblies, to measure neutron flux distribution.

Instrumentation is located in the core so that by correlating movable neutron detector information with fixed thermocouple information, radial, axial, and azimuthal core characteristics may be obtained for all core quadrants. The incore instrumentation obtains data from which fission power density distribution in the core, coolant enthalpy distribution in the core, and fuel burnup distribution may be determined. The core-exit thermocouples provide a backup to the flux monitoring instrumentation for monitoring power distribution.

2.3.1.5.2 Staff Evaluation

The staff reviewed LRA Section 2.3.1.5 and UFSAR Section 4.4.5.1, Incore Instrumentation, to determine whether the incore instrumentation system components that are within the scope of license renewal and subject to an AMR had been identified in accordance with the requirements of 10 CFR 54.4 and 10 CFR 54.21(a)(1), respectively. The staff review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

As part of the evaluation, the staff determined whether the applicant had properly identified the SSCs within the scope of license renewal and subject to an AMR, pursuant to 10 CFR 54.4(a) and 10 CFR 54.21(a)(1). The staff reviewed the relevant portions of the UFSAR for the incore instrumentation system and associated pressure boundary components, and compared the information in the UFSAR with the information in the LRA, to identify those portions that the LRA did not identify as being within the scope of license renewal and subject to an AMR. The staff then reviewed the structures and components that were identified as not being within the scope of license renewal to verify that these structures and components do not have any of the intended functions delineated under 10 CFR 54.4(a), and for those SCs that have an applicable intended function(s), to verify that they either perform this function(s) with moving parts or a change in configuration or properties, or that they are subject to replacement based on a qualified life or specified time period, as described in 10 CFR 54.21(a)(1).

The staff also reviewed the UFSAR for any function(s) delineated under 10 CFR 54.4(a) that were not identified as intended function(s) in the LRA, to verify that the SSCs with such function(s) will be adequately managed so that the function(s) will be maintained consistent with the CLB for the period of extended operation.

The components of the incore instrumentation system that would be within the scope of license renewal, in accordance with the requirements of 10 CFR 54.4(a), are long-lived, passive components, and pressure-retaining components. These are the incore neutron flux detector thimbles, the pressure-retaining incore thermocouples, and various pressure-retaining tubes and tube fittings. Unlike the surrounding fuel element assemblies, these incore instrumentation system components are not replaced periodically. They provide guidance and pathways through which instrument sensors are routed, and these pathways constitute part of the pressure-retaining boundary. The incore instrumentation system components are basically pressure-retaining tubes, made of a stainless steel and nickel based alloy, that must withstand a borated water environment.

No omissions of SSCs that are within the scope of license renewal and subject to an AMR, were found.

2.3.1.5.3 Conclusions

The staff reviewed the information presented in Section 2.3.1.5 of the LRA and the supporting information in UFSAR Section 4.4.5.1, Incore Instrumentation, to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. No omissions were found. On this basis, the staff concludes that the applicant has adequately identified the incore instrumentation components that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has adequately identified the reactor incore instrumentation components that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.1.6 Pressurizer

The applicant describes the pressurizer in LRA Section 2.3.1.6 and provides a list of components subject to an AMR, along with their component intended functions, in LRA Table 2.3-6. UFSAR Section 5.5.10, pressurizer, provides additional information concerning the pressurizer.

2.3.1.6.1 Summary of Technical Information in the Application

The pressurizer is a vertical, cylindrical vessel with hemispherical top and bottom heads. A pressurizer surge line connects the pressurizer to one of the hot legs in the reactor coolant system. The line enables continuous coolant volume pressure adjustments between the reactor coolant system and the pressurizer. The surge line nozzle and removable electric heaters are installed in the bottom head of the vessel, while spray line nozzles and relief and safety valve connections are located in the top head.

The components of the pressurizer, subject to an AMR, include the following major components and their associated subcomponents:

- pressurizer upper and lower heads
- immersion heater well assemblies
- manway cover and bolts
- nozzle safe ends and thermal sleeves
- shell barrel
- tubing (instrumentation and sample lines) and tube couplings

The intended functions identified for the pressurizer components were pressure boundary and heat transfer.

2.3.1.6.2 Staff Evaluation

The staff reviewed LRA Section 2.3.1.6 and UFSAR Section 5.5.10 to determine whether the pressurizer within the scope of license renewal and subject to an AMR had been identified in accordance with 10 CFR 54.4 and 54.21(a)(1).

In the performance of the review, the staff selected system functions described in the UFSAR that were set forth in 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of the Rule. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted.

The pressurizer, a safety-related, in-scope component, contains a spray head, a non-safety-related component, which the applicant has not included in the license renewal scope.

The spray head distributes normal and auxiliary pressurizer spray water into the pressurizer steam bubble, which tends to depressurize the pressurizer, and hence the reactor coolant system. Since the normal and auxiliary pressurizer sprays are not safety systems, they cannot be relied upon to function during any of the Chapter 15 accident analyses, unless, in some postulated analysis cases, pressurizer spray could have an aggravating effect upon the transient results (e.g., by delaying a high pressurizer pressure reactor trip). Therefore, the spray function is not credited for the mitigation of any accidents addressed in the UFSAR accident analyses.

As a non-safety-related component that is wholly enclosed by the pressurizer, a safety-related component, the pressurizer spray head would be subject to the requirements of 10 CFR 54.4(a)(2), which state, “Plant systems, structures, and components within the scope of this part are .... All non-safety-related systems, structures, and components whose failure could prevent satisfactory accomplishment of any of the functions identified in paragraphs (a)(1)(i), (ii), or (iii) of this section.” Paragraphs (a)(1)(i), (ii), and (iii) of this section address the integrity of the reactor coolant pressure boundary, the capability to shut down the reactor and maintain it in a safe shutdown condition, and the capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposures, respectively.

Normal and auxiliary pressurizer sprays are used to reduce the primary side coolant pressure, and to end the primary to secondary side tube break flow, following a steam generator tube rupture event. If, for some reason, the spray head fails in such a way as to block all spray flow, then normal and auxiliary sprays would become unavailable for depressurization following a steam generator tube rupture event. Since there is always some spray flow into the

pressurizer, during normal operation, it is expected that such a failure would be promptly detected and rectified.

If the pressurizer spray head were to degrade and crack, and shed one or more pieces of the head, these pieces could become loose parts inside the pressurizer. During a pressurization transient, such as a loss of a normal feedwater event or a load rejection, the power-operated relief valves, or even the code safety valves, might open. A loose part, inside the pressurizer, might be drawn into the throat of a power-operated relief valve or a code safety valve, and impede the ability of the pressurizer and its pressure relieving valves to protect the integrity of the reactor coolant pressure boundary. Depending upon the position of the loose part, inside the valve throat, the loose part might prevent the valve from reseating properly, and thereby transform a pressurization event into a depressurization event.

Although loose pieces of the spray head are not likely to damage the pressurizer itself, these pieces have the potential to impair certain safety-related functions of the pressurizer, such as the power-operated relief valves or the safety valves, during pressurization transients. The possibility that such loose parts might be generated and that they might impair certain safety functions of the pressurizer is not, by itself, sufficient to require that the pressurizer spray head be included in the license renewal scope. There must be some basis, in operating experience, that such a scenario could be reasonably expected to occur sometime during the 20-year license extension, following a 40-year aging period. To date, there have been no recorded instances of this type of failure. Therefore, without an experiential basis, the requirements of 10 CFR 54.4(a)(2) would not be applicable to the pressurizer spray head.

By letter dated April 9, 2003, the staff requested the applicant to indicate whether the pressurizer spray head is credited in the fire protection safe shutdown analysis to satisfy 10 CFR 50.48, Appendix R requirements. Section 54.4(a)(3) of Title *10 of the Code of Federal Regulations* requires that components that are used to satisfy the requirements of 10 CFR 50.48, Appendix R, must be included within the scope of license renewal. The specific intended function of the spray head that is subject to the 10 CFR 54.4(a)(3) requirement is the spray function. The spray head does not have a pressure boundary function.

In response, the applicant stated that the pressurizer spray is not credited to depressurize the reactor coolant system in the Appendix R event. Primary system depressurization is accomplished by opening the pressurizer power-operated relief valves. Therefore, the applicant has included the power-operated relief valves, not the pressurizer spray head, within the scope of license renewal. At the staff’s request, the applicant has confirmed that the pressurizer power-operated relief valves are included in the license renewal scope. They are listed in Table 2.3-2, under “Valves”.

Therefore, since the spray head (1) does not perform any intended functions, (2) its failure would not prevent satisfactory accomplishment of any of the functions identified in 10 CFR 54.4(a)(1), and (3) it is not relied upon to depressurize the reactor coolant system in an Appendix R scenario, the staff agrees with the applicant’s conclusion that the spray head need not be within the scope of license renewal.

No omissions of SSCs that are within the scope of license renewal and subject to an Aging Management Review, were found.

2.3.1.6.3 Conclusions

The staff reviewed LRA Section 2.3.1.6 and UFSAR Section 5.5.10 to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. No omissions were found. On the basis of this review, the staff concludes that the applicant has adequately identified the pressurizer SSCs that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has adequately identified the pressurizer SSCs that are subject to an Aging Management Review, as required by 10 CFR 54.21(a)(1).

2.3.1.7 Steam Generators

The applicant describes the steam generators in LRA Section 2.3.1.7 and provides a list of components subject to an AMR, along with their component intended functions, in LRA Table 2.3-7. UFSAR Section 5.5.2, Steam Generators, provides additional information concerning the steam generators.

2.3.1.7.1 Summary of Technical Information in the Application

VCSNS is equipped with three Westinghouse Delta-75 feedring-type steam generators. The steam generators can be described as vertical shell and inverted U-tube evaporators with integral moisture separating equipment. The reactor coolant flows through the U-tubes, entering and leaving through the nozzles located in the hemispherical bottom head of the steam generator. The head is divided into inlet and outlet chambers by a vertical partition plate extending from the head to the tubesheet. Manways are provided for access to both sides of the divided head.

The feedwater enters at approximately two-thirds (2/3) of the steam generator height and is distributed uniformly around the circumference of the steam generator shell, through a feedring. Feedwater enters the tube bundle by flowing downward between the steam generator external shell and inner wrapper barrel. An open area at the bottom of the wrapper barrel permits the feedwater to enter the tube bundle. Steam is generated and flows upward through the moisture separators and flow restrictor outlet nozzle at the top of the steam drum. High efficiency centrifugal steam separators remove most of the entrained water. Dryers are employed to increase the steam quality to a minimum of 99.90 percent (0.10 percent moisture).

The steam generators were installed during the Refuel 8 outage, in the fall of 1994. They replaced the original equipment — Westinghouse model D3 steam generators. The D3 steam generator design had employed an integral preheater at the feedwater inlet. The total steam generator heat transfer surface area is relatively greater in the Delta-75, in order to account for the thermal performance characteristics of the preheaters in the original D3 steam generators. In order to facilitate the replacement, key dimensions of the Delta-75 steam generators are identical to those of the original D3 steam generators. The performance characteristics of the Delta-75 steam generators match or exceed those of the original steam generators.

2.3.1.7.2 Staff Evaluation

The staff reviewed LRA Section 2.3.1.7 and UFSAR Section 5.5.2 to determine whether the steam generator components are within the scope of license renewal and subject to an AMR had been identified in accordance with 10 CFR 54.4 and 54.21(a)(1).

In the performance of the review, the staff selected system functions described in the UFSAR that were set forth in 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of the Rule. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted.

Among the components included in the license renewal scope are the steam generator feedwater distribution rings and the integral steam outlet nozzle flow-limiting venturis.

The staff observes, only as a point of interest, that since the VCSNS steam generators were replaced in 1994, they will be 48 years old by the end of the extended license period, in 2042. For these particular steam generators, therefore, the license extension period would amount to 8 years, not 20.

No omissions of SSCs that are within the scope of license renewal and subject to an AMR were found.

2.3.1.7.3 Conclusions

The staff reviewed LRA Section 2.3.1.7 and UFSAR Section 5.5.2, Steam Generators, to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. No omissions were found. On the basis of this review, the staff concludes that the applicant has adequately identified the steam generator SSCs that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has adequately identified the steam generator SSCs that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.2 Engineered Safety Features Systems

Engineered safety features (ESF) are provided to mitigate the consequences of postulated accidents up to and including a design basis accident. The ESF systems provided for VCSNS have sufficient redundancy and independence of components and power sources that, under postulated accident conditions, (1) core cooling limits the core thermal transient, (2) reactor building structural integrity is maintained, and (3) radiation dose to the public is maintained within the limits of 10 CFR Part 100, are accomplished.

2.3.2.1 Chemical and Volume Control

The applicant describes the chemical and volume control system in LRA Section 2.3.2.1 and provides a list of components subject to an AMR, along with their component intended functions, in LRA Table 2.3-8. UFSAR Section 6.3, Emergency Core Cooling System, and UFSAR Section 9.3.4, Chemical and Volume Control System, provide additional information concerning the chemical and volume control system.

2.3.2.1.1 Summary of Technical Information in the Application

The chemical and volume control system is designed to perform the following functions, with respect to the reactor coolant system:

- maintenance of programmed water level in the pressurizer (i.e., maintain required water inventory in the reactor coolant system
- maintenance of seal-water injection flow to the reactor coolant pumps
- control of reactor coolant water chemistry conditions, activity level, soluble chemical neutron absorber concentration and makeup
- provide means for filling, draining, and pressure testing of the reactor coolant system
- emergency core cooling (part of the system is shared with the emergency core cooling system)

The component types which were identified for the chemical and volume control system include agitators and mixers, demineralizers, filters, flexible couplings, gearboxes, heat exchanger channel heads, shells, tubesheets and tubes orifices, pipe, pressure-retaining instrumentation, oil reservoirs, pump bearing housings and casings, tanks, tubes and tubefittings, and valve bodies. The intended functions identified for the chemical and volume control system components were pressure boundary, filtration, throttling, and heat transfer.

2.3.2.1.2 Staff Evaluation

The staff reviewed LRA Section 2.3.2.1 and UFSAR Sections 6.3 and 9.3.4 to determine whether the chemical and volume control system components and supporting structures within the scope of license renewal and subject to an AMR had been identified in accordance with the requirements of 10 CFR 54.4 and 10 CFR 54.21(a)(1), respectively. The staff review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

As part of the evaluation, the staff determined whether the applicant had properly identified the SSCs within the scope of license renewal and subject to an AMR, pursuant to 10 CFR 54.4(a) and 10 CFR 54.21(a)(1). The staff reviewed the relevant portions of the UFSAR for the chemical and volume control system, and associated pressure boundary components, and compared the information in the UFSAR with the information in the LRA to identify those portions that the LRA did not identify as being within the scope of license renewal and subject to an AMR. The staff then reviewed the SCs that were identified as not being within the scope of license renewal to verify that these SCs do not have any of the intended functions delineated under 10 CFR 54.4(a), and for those SCs that have an applicable intended function(s), to verify that they either perform this function(s) with moving parts or a change in configuration or properties, or that they are subject to replacement based on a qualified life or specified time period, as described in 10 CFR 54.21(a)(1).

The staff also reviewed the UFSAR for any function(s) delineated under 10 CFR 54.4 (a) that were not identified as intended function(s) in the LRA, to verify that the SSCs with such

function(s) will be adequately managed so that the function(s) will be maintained consistent with the CLB for the period of extended operation.

Since part of the chemical and volume control system (e.g., the charging pumps) is shared with the emergency core cooling system (see Section 2.3.2.7 of this report, Safety Injection System), certain components of the chemical and volume control system are used to perform the safety-related functions specified in 10 CFR 54.4(a)(1). The chemical and volume control system operates in conjunction with the refueling water, residual heat removal, and safety injection systems to deliver borated emergency core cooling water to the reactor coolant system following a LOCA. During the injection phase, the centrifugal charging pumps in the chemical and volume control system, along with the residual heat removal pumps, draw suction from the refueling water storage tank and inject borated water directly into the reactor coolant system.

No omissions of SSCs that are within the scope of license renewal and subject to an AMR were found.

2.3.2.1.3 Conclusions

The staff reviewed LRA Section 2.3.2.1 and UFSAR Sections 6.3 and 9.3.4 to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. No omissions were found. On this basis, the staff concludes that the applicant has adequately identified the chemical and volume control system components that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has adequately identified the chemical and volume control system components that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.2.2 Containment Isolation System

2.3.2.2.1 Summary of Technical Information in the Application

The applicant describes the containment isolation system in LRA Section 2.3.2.2 and provides a list of components subject to an AMR in LRA Tables 2.3-9, 2.3-10, 2.3-11, and 2.3-12. The system is further described in UFSAR Section 6.2.4, Containment Isolation System.

The objective of the containment isolation system is to allow the passage of fluids through the containment boundary under normal and accident conditions, while preserving the integrity of the containment boundary, when required to prevent or limit the escape of fission products as a result of a postulated LOCA.

The containment isolation system is not an independent system. Rather, the system is comprised of specific features included in each piping system that penetrates the reactor building. Actuation of containment isolation is accomplished through the engineered safety features actuation system.

Four systems at VCSNS have been identified whose only mechanical license renewal function is to provide containment isolation. These systems are — auxiliary coolant (closed loop)/CRDM

cooling water (AC), demineralized water — nuclear services (DN), nitrogen blanketing (NG), and reactor building leak rate testing (LR).

The auxiliary coolant/CRDM AC system is designed to remove heat from the containment air used to cool the CRDM and dissipate this heat to the atmosphere via the industrial cooler.

The DN system is designed to clarify, filter, and demineralize raw water from Monticello Reservoir for distribution to the nuclear steam supply system (NSSS), secondary (turbine) cycle, and other miscellaneous plant systems.

The NG system is designed to provide pressurized nitrogen to hose connections located inside containment.

The reactor building leak rate testing system is designed to permit containment leakage testing in accordance with 10 CFR Part 50, Appendix J.

2.3.2.2.2 Staff Evaluation

The staff reviewed LRA Section 2.3.2.2 and UFSAR Section 6.2.4 to determine whether the containment isolation system components within the scope of license renewal and subject to an AMR had been identified in accordance with 10 CFR 54.4 and 54.21(a)(1), respectively. The staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

In the performance of the review, the staff selected system functions described in the UFSAR that were set forth in 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of the Rule. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted. As a result of this review, the staff did not identify any omissions.

2.3.2.2.3 Conclusions

The staff reviewed the LRA, the accompanying scoping boundary drawings, and the applicant's RAI response to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. No omissions were found. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. No omissions were found. On the basis of this review, the staff concludes that the applicant has adequately identified the components of the containment isolation system that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has adequately identified the components of the containment isolation system that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.2.3 Hydrogen Removal — Post Accident System

2.3.2.3.1 Summary of Technical Information in the Application

The applicant describes the hydrogen removal — post accident system in LRA Section 2.3.2.3 and provides a list of components subject to an AMR in LRA Table 2.3-13. The system is further described in UFSAR Section 6.2.5, Combustible Gas Control in Reactor Building.

The hydrogen removal — post accident system is designed for control of combustible hydrogen concentrations in the reactor building following a LOCA. The system uses electric hydrogen recombiners as a primary means of reducing hydrogen concentrations, while a purge system is provided as a backup to the recombiners.

2.3.2.3.2 Staff Evaluation

The staff reviewed LRA Section 2.3.2.3 and UFSAR Section 6.2.5 to determine whether the hydrogen removal—post accident system components within the scope of license renewal and subject to an AMR had been identified in accordance with 10 CFR 54.4 and 54.21(a)(1), respectively. The staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

In the performance of the review, the staff selected system functions described in the UFSAR that were set forth in 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of the Rule. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted. As a result of this review, the staff did not identify any omissions.

2.3.2.3.3 Conclusions

The staff reviewed the LRA and the accompanying boundary drawings to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. No omissions were found. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. No omissions were found. On the basis of this review, the staff concludes that the applicant has adequately identified the components of the hydrogen removal—post accident system that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has adequately identified the components of the hydrogen removal—post accident system that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.2.4 Reactor Building Spray System

2.3.2.4.1 Summary of Technical Information in the Application

The applicant describes the reactor building spray system in LRA Section 2.3.2.4 and provides a list of components subject to an AMR in LRA Table 2.3-14. The system is further described in UFSAR Section 6.2.2, Reactor Building Heat Removal Systems.

The basic functions of the reactor building spray system are to (1) remove the thermal energy released to containment by a LOCA at a rate sufficient to limit the resulting over-pressurization to a level below the design limit, thereby maintaining containment structural integrity, and (2) to subsequently reduce the over-pressure to a level that minimizes the pressure differential which induces leakage out of containment. An additional function of the reactor building spray system is to reduce the concentration of airborne radioactive iodine in the containment atmosphere.

These functions are accomplished by spraying water containing sodium hydroxide into the containment atmosphere to absorb heat, condense steam, and remove airborne radioactive iodine from the steam-air atmosphere.

During normal plant operation, the reactor building spray system is in a standby condition. Operation of the system is automatically initiated following a LOCA or main steam line break (MSLB) by signals from the engineered safety features (ESF) actuation system, when the reactor building pressure increases to the actuation set point.

2.3.2.4.2 Staff Evaluation

The staff reviewed LRA Section 2.3.2.4 and UFSAR Section 6.2.2 to determine whether the reactor building spray system components within the scope of license renewal and subject to an AMR had been identified in accordance with 10 CFR 54.4 and 54.21(a)(1), respectively. The staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

In the performance of the review, the staff selected system functions described in the UFSAR that were set forth in 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of the Rule. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted. As a result of this review, the staff did not identify any omissions.

2.3.2.4.3 Conclusions

The staff reviewed the LRA and the accompanying boundary drawings to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. No omissions were found. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. No omissions were found. On the basis of this review, the staff concludes that the applicant has adequately identified the components of the reactor building spray system that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has adequately identified the components of the reactor building spray system that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.2.5 Refueling Water System

2.3.2.5.1 Summary of Technical Information in the Application

The applicant describes the refueling water system in LRA Section 2.3.2.5 and provides a list of components subject to an AMR in LRA Table 2.3-15. The system is further described in UFSAR Section 6.3, Emergency Core Cooling System, and UFSAR Section 9.1.3, Spent Fuel Cooling System.

The primary function of the refueling water system is to support refueling operations, refueling water cleanup, spent fuel pool makeup, and other borated water needs associated with plant operations. The refueling water system also operates in conjunction with the chemical and volume control, residual heat removal, and safety injection systems to deliver borated emergency core cooling water to the reactor coolant system following a LOCA. During the injection phase, the refueling water storage tank provides an adequate supply of borated water for the residual heat removal and centrifugal charging pumps for injection directly into the reactor coolant system.

2.3.2.5.2 Staff Evaluation

The staff reviewed LRA Section 2.3.2.5 and UFSAR Sections 6.3 and 9.1.3 to determine whether the refueling water system components within the scope of license renewal and subject to an AMR had been identified in accordance with 10 CFR 54.4 and 54.21(a)(1), respectively. The staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

In the performance of the review, the staff selected system functions described in the UFSAR that were set forth in 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of the Rule. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted. As a result of this review, the staff did not identify any omissions.

2.3.2.5.3 Conclusions

The staff reviewed the LRA and the accompanying boundary drawings to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. No omissions were found. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. No omissions were found. On the basis of this review, the staff concludes that the applicant has adequately identified the components of the refueling water system that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has adequately identified the components of the refueling water system that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.2.6 Residual Heat Removal System

The applicant describes the residual heat removal system in LRA Section 2.3.2.6 and provides a list of components subject to an AMR, along with their component intended functions, in LRA Table 2.3-16. The license renewal evaluation boundaries for the residual heat removal system are depicted on drawing E-302-641, Residual Heat Removal. UFSAR Section 6.3, Emergency Core Cooling System, provides additional information concerning the residual heat removal system.

2.3.2.6.1 Summary of Technical Information in the Application

The primary function of the residual heat removal system is to remove radioactive decay heat energy from the core, and sensible and pump heat from the reactor coolant system during plant cooldown and refueling operations. The residual heat removal system also operates in conjunction with the chemical and volume control, refueling water and safety injection systems to deliver borated emergency core cooling water to the reactor coolant system following a LOCA.

The system operation is categorized in two phases, injection and recirculation. During the injection phase, the residual heat removal pumps, along with the centrifugal charging pumps in the chemical and volume control system, draw suction from the refueling water storage tank and inject borated water directly into the reactor coolant system. During the recirculation phase, the residual heat removal pumps draw suction from the containment sump, remove

decay heat via the residual heat removal system heat exchangers, and then deliver flow to the charging pumps suction and to the reactor coolant system. As during the injection phase, the charging pumps then inject borated water directly into the reactor coolant system.

The component types which were identified for the residual heat removal system include heat exchanger channel heads, shells, tubesheets and tubes, orifices, pipe, tubes and tube fittings, pump casings, and valve bodies. The intended functions identified for the residual heat removal system components were pressure boundary, throttling, and heat transfer.

2.3.2.6.2 Staff Evaluation

The staff reviewed LRA Section 2.3.2.6 and UFSAR Section 6.3, Emergency Core Cooling System, to determine whether the residual heat removal system components and supporting structures within the scope of license renewal and subject to an AMR had been identified in accordance with the requirements of 10 CFR 54.4 and 10 CFR 54.21(a)(1), respectively. The staff review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

As part of the evaluation, the staff determined whether the applicant had properly identified the SSCs within the scope of license renewal and subject to an AMR, pursuant to 10 CFR 54.4(a) and 10 CFR 54.21(a)(1). The staff reviewed the relevant portions of the UFSAR for the residual heat removal system and associated pressure boundary components and compared the information in the UFSAR with the information in the LRA to identify those portions that the LRA did not identify as being within the scope of license renewal and subject to an AMR. The staff then reviewed the SCs that were identified as not being within the scope of license renewal to verify that these SCs do not have any of the intended functions delineated under 10 CFR 54.4(a), and for those SCs that have an applicable intended function(s), to verify that they either perform this function(s) with moving parts or a change in configuration or properties, or that they are subject to replacement based on a qualified life or specified time period, as described in 10 CFR 54.21(a)(1).

The staff also reviewed the UFSAR for any function(s) delineated under 10 CFR 54.4(a) that were not identified as intended function(s) in the LRA, to verify that the SSCs with such function(s) will be adequately managed so that the function(s) will be maintained consistent with the CLB for the period of extended operation.

Since the residual heat removal system also operates in conjunction with the refueling water, chemical and volume control, and safety injection systems to deliver borated emergency core cooling water to the reactor coolant system following LOCA, certain components of the residual heat removal system are used to perform the functions specified in 10 CFR 54.4(a)(1).

No omissions of SSCs that are within the scope of license renewal and subject to an AMR were found.

2.3.2.6.3 Conclusions

The staff reviewed LRA Section 2.3.2.6 and UFSAR Section 6.3, Emergency Core Cooling System, to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. In addition, the staff performed an independent assessment to

determine whether any components subject to an AMR had not been identified by the applicant. No omissions were found. On this basis, the staff concludes that the applicant has adequately identified the residual heat removal system components that are within the scope of license renewal as required by 10 CFR 54.4(a) and that the applicant has adequately identified the residual heat removal system components that are subject to an AMR as required by 10 CFR 54.21(a)(1).

2.3.2.7 Safety Injection System

The applicant describes the safety injection system in LRA Section 2.3.2.7 and provides a list of components subject to an AMR, along with their component intended functions, in LRA Table 2.3-17. UFSAR Section 6.3, Emergency Core Cooling System, provides additional information concerning the safety injection system.

2.3.2.7.1 Summary of Technical Information in the Application

The safety injection system pumps borated water into the reactor coolant system to provide emergency core cooling following a LOCA. This provides core cooling to ensure there is no significant alteration of core geometry, no clad melting, no fuel melting, and less than one percent cladding water reaction. This also limits fission product release and ensures adequate shutdown margin regardless of temperature. The safety injection system also provides continuous long-term post-accident cooling of the core by recirculation of borated water from the containment recirculation line inlet located in the containment sump.

In the event of an accident, two charging pumps are started automatically on receipt of a safety injection signal and are automatically aligned to take suction from the refueling water storage tank during injection. The centrifugal charging pumps deliver borated water at the prevailing reactor coolant system pressure to the cold legs of the reactor coolant system. The residual heat removal pumps take suction from the refueling water storage tank and deliver borated water to the reactor coolant system. These pumps begin to deliver water to the reactor coolant system only after the pressure has fallen below the pump shutoff head. During recirculation, suction is provided by the residual heat removal pumps.

The safety injection signal is actuated by any of the following:

- low pressurizer pressure
- high reactor building pressure
- high differential pressure between any two steam lines
- low steam line pressure
- manual actuation

Operation of the emergency core cooling system during the injection mode is completely automatic. The safety injection signal automatically initiates the following actions

- starts the emergency diesel generators, which if all other sources of power are lost, supplies the engineered safety feature buses

- starts the charging pumps and the residual heat removal pumps

- aligns the charging pumps for injection

The injection mode continues until the residual heat removal pumps have been realigned to the recirculation mode. During the injection mode, all pumps take suction from the refueling water storage tank until a lo-lo level signal from the refueling water storage tank aligns the residual heat removal pumps to take suction from the reactor building sump.

After the injection operation, water collected in the reactor building sump is cooled and returned to the reactor coolant system via the low/high head recirculation flow paths. The residual heat removal pumps are aligned to take suction from the reactor building sump, to deliver directly to the reactor coolant system and to supply suction to the charging pumps. The charging pumps deliver flow directly to the reactor coolant system cold legs. This latter mode of operation assures flow in the event of a small rupture where the depressurization proceeds more slowly such that the reactor coolant system pressure is still in excess of the shutoff head of the residual heat removal pumps at the onset of recirculation.

The safety injection system component types, listed in Table 2.3-17 of the LRA, include orifices, pipe, tanks, tube and tube fittings, and valve bodies. The intended functions identified for the safety injection system components were pressure-retaining boundary and throttling.

2.3.2.7.2 Staff Evaluation

The staff reviewed LRA Section 2.3.2.7 and UFSAR Section 6.3, Emergency Core Cooling System, to determine whether the safety injection system components and supporting structures within the scope of license renewal and subject to an AMR had been identified in accordance with the requirements of 10 CFR 54.4 and 10 CFR 54.21(a)(1), respectively. The staff review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

As part of the evaluation, the staff determined whether the applicant had properly identified the SSCs within the scope of license renewal and subject to an AMR, pursuant to 10 CFR 54.4(a) and 10 CFR 54.21(a)(1). The staff reviewed the relevant portions of the UFSAR for the safety injection system and associated pressure boundary components and compared the information in the UFSAR with the information in the LRA to identify those portions that the LRA did not identify as being within the scope of license renewal and subject to an AMR. The staff then reviewed the SCs that were identified as not being within the scope of license renewal to verify that these structures and components do not have any of the intended functions delineated under 10 CFR 54.4(a), and for those SCs that have an applicable intended function(s), to verify that they either perform this function(s) with moving parts or a change in configuration or properties, or that they are subject to replacement based on a qualified life or specified time period, as described in 10 CFR 54.21(a)(1).

The staff also reviewed the UFSAR for any function(s) delineated under 10 CFR 54.4 (a) that were not identified as intended function(s) in the LRA, to verify that the SSCs with such function(s) will be adequately managed so that the function(s) will be maintained consistent with the CLB for the period of extended operation.

No omissions of SSCs that are within the scope of license renewal and subject to an AMR were found.

2.3.2.7.3 Conclusions

The staff reviewed LRA Section 2.3.2.7 and UFSAR Section 6.3, Emergency Core Cooling System, to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. No omissions were found. On this basis, the staff concludes that the applicant has adequately identified the safety injection system components that are within the scope of license renewal as required by 10 CFR 54.4(a) and that the applicant has adequately identified the safety injection system components that are subject to an AMR as required by 10 CFR 54.21(a)(1).

2.3.3 Auxiliary Systems

The auxiliary systems are those systems used to support normal and emergency plant operations. The systems provide cooling, ventilation, sampling, and other required functions.

2.3.3.1 Air Handling and Local Ventilation and Cooling Systems

2.3.3.1.1 Summary of Technical Information in the Application

The applicant describes the air handling and local ventilation and cooling systems in LRA Section 2.3.3.1 and provides a list of components subject to an AMR in LRA Table 2.3-18. UFSAR Section 9.4, "Air Conditioning, Heating, Cooling and Ventilation Systems, provides additional information for these systems.

The following systems are included in the air handling and local ventilation and cooling systems:

1.1 Control Building Area Ventilation Systems
1.2 Auxiliary and Radwaste Area Ventilation System
1.3 Fuel Handling Building Ventilation
1.4 Intermediate Building Ventilation Systems
1.5 Miscellaneous Building Ventilation and Cooling Systems
1.6 Reactor Building Cooling and Filtering Systems

These systems are described below.

<u>Control Building Area Ventilation Systems</u>

The control building area ventilation systems (CBAVS) consist of control room system, relay room system, computer room system, controlled access area supply system, miscellaneous room systems, controlled access area exhaust system, and computer rooms and safety assessment system (SAS) room cooling system. The control room and relay room ventilation systems are designed, protected and arranged with sufficient redundancy to ensure system cooling and filtering operation after a LOCA. The ventilation systems in the control room and relay room areas are independent of each other. Each area is served by two separated, independent heating, ventilation, and air conditioning (HVAC) and filtering subsystems, which are supplied from separate Class 1E electric power supplies.

The control room ventilation system continuously supplies filtered, cooled, or heated air to the control room, technical support center, and cable spreading area during normal conditions. Filtered and cooled air is provided during post accident and loss of offsite power conditions. The control room ventilation system consists of two 100 percent-capacity air handling units with cooling coils, two 100 percent-capacity emergency filter systems, and electric reheat coils in the supply ducts, controls, and associated dampers and ductwork.

The relay room ventilation system continuously supplies filtered, cooled, or heated air to the relay room under normal conditions. Filtered and cooled air is provided under post accident and loss of offsite power conditions. The cooling coil is supplied by the safety-related chilled water system. The relay room system consists of two 100 percent-capacity air handling units with roughing filters, chilled water cooling coil and fan section, electric reheat coils in the supply ducts, controls, and associated dampers and ductwork.

The gaseous activity channel of the radiation monitor automatically closes the outside air dampers of the relay room and places both systems in recirculation or emergency mode upon detection of high gaseous activity in the air supplied to the control room.

During normal and emergency operations, the control room is pressurized through the introduction of a fixed amount of outside air. The flow of outside air to the relay room is fixed but is manually adjustable. In the emergency mode, control room air is filtered through roughing, high efficiency particulate air (HEPA), and charcoal filters. Recirculated air in the relay room is not filtered.

For smoke removal, system dampers for both control and relay room systems can be positioned manually to purge with outside air at rates up to 100 percent. Prior to purging the control room, the relief damper and outside air duct blanking plates must be removed in conjunction with closing the system return air damper.

The computer room system continuously supplies filtered, cooled, or heated air to the computer room under normal and post accident conditions whenever offsite power is available by two - 100 percent-capacity air handling units. The cooling coil is supplied by the non-safety-related chilled water system. The units are connected to Class 1E power buses. The units are normally operated from the control room.

The controlled access area supply system continuously supplies filtered, cooled, or heated air to the four zones of the controlled access area under normal and post accident conditions whenever offsite power is available. The system is connected to Class 1E buses.

The controlled access area exhaust system operates continuously under normal and emergency conditions whenever offsite power is available. The main components of the system include a 100 percent-capacity controlled access area filter plenum, including roughing filters, HEPA filters, charcoal filters, and post-HEPA filters down stream of the charcoal filters.

The SAS/central processing unit (CPU) computer rooms cooling system continuously supplies filtered, cooled, or heated air to the SAS/CPU computer rooms when normal power is available by a 32 percent-capacity air handling unit and a 68 percent-capacity air handling unit including roughing filters. Chilled water is provided by the non-safety-related chilled water system.

The microwave relay room system continuously supplies filtered, cooled, or heated air to the microwave relay room when normal power is available by a 100 percent-capacity air conditioning unit, including refrigeration system, electric heating coil, and fan.

The microwave battery room system continuously exhausts air from the microwave battery room to the atmosphere when normal power is available by a 100 percent-capacity exhaust fan.

The control building office space system provides cooling for personnel comfort by a 100 percent-capacity air handling unit with roughing filter and refrigerant coil and a 100 percent-capacity remotely mounted condensing unit including compressor and controls.

The control building elevator machine room system cyclically exhausts air from the elevator machine room to the atmosphere in response to a room thermostat by a 100 percent-capacity exhaust fan and a 100 percent-capacity electric unit heater when normal power is available.

The license renewal boundaries of the CBAVS are depicted on the following P&ID drawings:

- D-806-001, Radiation Monitoring System Flow Diagram
- D-912-136, Relay and Computer Room Cooling System Flow Diagram
- D-912-140, Control Room Normal and Emergency Air Handling System Flow Diagram
- D-912-141, Technical Support Center and Main Control Board Ventilation Flow Diagram
- D-912-154, Computer Rooms and SAS Room Cooling Unit System Flow Diagram

In LRA Section 2.3.3.1 and UFSAR Section 9.4.1, the applicant identified the following intended functions for the CBAVS:

- to maintain ambient air temperatures in all areas as required for the comfort and safety of personnel

- to satisfy environmental requirements of equipment

- to meet the radiation control requirements of 10 CFR Part 20

- to satisfy the design requirements of General Design Criterion 19, relative to the control room

In LRA Table 2.3-18, the applicant identified the component types for the CBAVS that are subject to an AMR. In LRA Tables 3.3-1 and 3.3-2, the applicant identified the component types and commodities groups (combinations of materials and environments) that are within the AMP that are evaluated in NUREG-1801, "Generic Aging Lessons Learned (GALL) Report."

<u>Auxiliary and Radwaste Area Ventilation System</u>

The auxiliary and radwaste area ventilation system (ARAVS) consists of auxiliary building main supply system, auxiliary building HEPA exhaust system, auxiliary building charcoal exhaust system, auxiliary building main exhaust system, auxiliary building pump room and motor control center cooling systems, hot machine shop ventilation system, and fuel handling building charcoal exhaust system and air supply distribution. The ARAVS maintains ambient air temperature in all areas between minimum and maximum levels suitable for personnel and

equipment. It also minimizes the release of radioactive airborne particulates and gaseous activity to the atmosphere and provides filtration for the refueling water storage tank vent discharge.

The ARAVS, excluding pump room, motor control center, and switchgear cooling units (elevations 412’ and 463’), is not a safety-related system. However, redundant fans are provided for the main exhaust, the charcoal exhaust, and the HEPA exhaust systems. Charcoal exhaust fans and plenums are physically separated, housed in shielded concrete enclosures, and the fans receive power from the Class 1E electric system. All charcoal and HEPA filter plenums are constructed in accordance with Seismic Category I requirements. Radiation levels in the charcoal filters, the exhaust from the gas decay vent, and the main plant vent exhaust are monitored from the control room.

The auxiliary building pump room cooling system serves each charging pump, residual heat removal and reactor building spray pump room with a 100 percent-capacity air handling unit consisting of a fan section, chilled water coil, and a roughing filter. The air handling units are powered from Class 1E electric system. The ventilation units are administratively controlled from the control room during normal operation or refueling.

The safety-class motor control center and switchgear areas of the auxiliary building (elevations 412’ and 463’) are served by three 100 percent-capacity air handling units. The safety-related air handling units include a fan section, chilled water coil, and roughing filter. Power is suppled to the safety-related units from separated and independent Class 1E power sources.

The license renewal boundaries for the ARAVS are depicted on the following P&ID drawings:

- D-912-132, Auxiliary Building Pump Room Cooling System Flow Diagram
- D-912-120, Auxiliary Building HEPA System Flow Diagram

In LRA Section 2.3.3.1 and UFSAR Section 9.4.1, the applicant identified the following intended functions for the ARAVS:

- to maintain ambient air temperatures in all areas between minimum and maximum levels suitable for personnel and equipment

- to minimize the release of radioactive airborne particulate and gaseous activity to the atmosphere

- to provide for filtration of the refueling water storage tank vent discharge

In LRA Table 2.3-18, the applicant identified the component types for the ARAVS that are subject to an AMR. In LRA Tables 3.3-1 and 3.3-2, the applicant identified the component types and commodities groups (combinations of materials and environments) that are within the AMP that are evaluated in the GALL Report.

<u>Fuel Handling Building Ventilation</u>

The fuel handling building ventilation (FHBV) consists of fuel handling building supply

and charcoal exhaust system. The FHBV continuously supplies outside air that has been drawn through the auxiliary building supply air plenums where it is filtered and heated as required. Ventilation exhaust air flow is directed from areas of low to progressively higher activity.

The total exhaust from the fuel handling building is drawn through the HEPA charcoal filters and ducted to the auxiliary building main exhaust fans and the main plant vent. Both fuel handling building exhaust fans operate following a loss of offsite power.

The exhaust system fans and filters are separated, shielded, and served by separate Class 1E electric power supplies. The fans and filters are Seismic Category I located in a Seismic Category I structure that are protected from floods, weather, external missiles, jet impingement, or pipe whip.

The supply and exhaust system are administratively controlled during normal operation or refueling. However, the exhaust system starts automatically upon loss of offsite power, thus ensuring that a negative pressure is maintained in the fuel handling building.

Exhaust air from the spent fuel area and from potentially radioactive areas of the fuel handling building are monitored for particulate, iodine, and gaseous activity. A control room alarm is actuated upon detection of high radiation. An ex-filtration analysis of the fuel handling building has been performed to verify that offsite doses resulting from a fuel handling accident inside the fuel handling building do not exceed 10 CFR Part 100 guidelines.

The license renewal boundaries of the FHBV are depicted on the following P&ID drawings:

- D-912-131, Fuel Handling Charcoal Exhaust/Air Supply Distrib. System Flow Diagram
- D-806-002, Radiation Monitoring System Flow Diagram

In LRA Section 2.3.3.1 and UFSAR Section 9.4.1, the applicant identified the following intended functions for the FHBV:

- to provide an environment suitable for personnel and equipment in the spent fuel pool area and the fuel handling building

- to minimize condensation from the fuel pool area and the release of airborne radioactivity

In LRA Table 2.3-18, the applicant identified the component types for the FHBV system that are subject to an AMR. In LRA Tables 3.3-1 and 3.3-2, the applicant identified the component types and commodities groups (combinations of materials and environments) that are within the AMP and are evaluated in the GALL Report.

Intermediate Building Ventilation Systems

The intermediate building ventilation systems (IBVS) consist of CRDM switchgear room cooling system, ESF switchgear rooms and speed switchgear rooms cooling systems, battery room systems, intermediate building ventilation system, intermediate building pump room cooling systems, and water chiller area ventilation systems. The CRDM switchgear room cooling

system, intermediate building ventilation system, and water chiller area ventilation systems operate continuously during all normal and shutdown operations unless normal power is not available. The intermediate building ventilation system provides heating, cooling, ventilation, and exhaust for various IBVS to the extent indicated to maintain ambient air temperatures in all areas between minimum and maximum levels suitable for personnel and equipment.

Because the IBVS are redundant, loss of one of the air handling units or fans will not prevent system function. For the ESF switchgear rooms cooling systems, one air handling unit serves the A-channel ESF switchgear and another separate air handling unit serves the B-channel ESF switchgear.

Safety-related equipment is powered by separated Class 1E power supplies. The units are administratively controlled from the control room. Upon receipt of a safety injection or loss of offsite power signal, the ESF switchgear room air handling units and speed switchgear rooms air handling units are automatically started and operated continuously.

ESF Switchgear Rooms and Speed Switch Room Cooling Systems:

The cooling system has one 100 percent-capacity air handling unit for each ESF switchgear room, one 100 percent-capacity air handling unit for the “A/C” speed switch room and evacuation panel room A, and one 100 percent-capacity air handling unit for the “B/C” speed switch room and evacuation panel room B. Each air handling unit consisted of a roughing filter, chilled water cooling coil, and a fan/motor section. The ventilation systems also have ductwork and I&C devices.

Under emergency conditions, the thermostatic control is bypassed, and the air handling units start and operate continuously following receipt of a safety injector or loss of an offsite power signal. Power is supplied to the air handling units from separated, independent Class 1E power sources. The air handling units are located in separate equipment rooms in the intermediate building.

Battery Room Ventilation Systems:

The battery room ventilation systems have two 100 percent-capacity air handling units, each with a roughing filter, electric heating coil, face and bypass section, safety-related chilled water cooling coil, fan and motor section. The battery room also has two 100 percent-capacity exhaust air fans, isolation dampers, and instrumentation and controls devices.

The battery room ventilation system operates during normal, shutdown, and emergency conditions. Continuous system operation maintains suitable ambient temperatures and prevents the accumulation of battery gases in these areas. The battery room air handling units and exhaust fans are powered by separated Class 1E power sources.

Intermediate Building Pump Room Cooling Systems:

The intermediate building pump room cooling systems have two 100 percent-capacity air handling units for each of the service water booster pump and emergency feedwater pump areas. Each air handling unit consists of a roughing filter, safety-related chilled water cooling coil, fan, and motor section.

The pump room air handling units start automatically with their respective pump. The air handling units remove heat generated due to normal equipment operation in the area. Upon detection of high ambient temperature condition in the area (which may be caused by a high energy line break), fan operation is prohibited until area temperatures return to design parameter operational levels. Air handling units are powered by separated Class 1E power sources and are located in separate equipment rooms in the intermediate building.

The license renewal boundaries for the IBVS are depicted on the following P&ID drawings:

- D-912-138, Battery Rm./Charger Rm./BOP Charger Area Ventilation System Flow Diagram
- D-912-139, CRDM SWGR Rm. Cooling & Water Chill. Area Vent. System Flow Diagram
- D-912-157, ESF SWGR Rooms/Speed Switch Rooms Cooling Systems Flow Diagram
- D-912-158, General Ventilation & Pump Area Cooling Systems Flow Diagram

In LRA Section 2.3.3.1 and UFSAR Section 9.4.1, the applicant identified the following intended functions for the IBVS:

- to maintain ambient air temperatures in all areas of the intermediate building between minimum and maximum levels suitable for personnel and equipment

- to furnish continuous outside air ventilation for the battery room ventilation system

In LRA Table 2.3-18, the applicant identified the component types for the IBVS that are subject to an AMR. In LRA Tables 3.3-1 and 3.3-2, the applicant identified the component types and commodity groups (combinations of materials and environments) that are within the AMP and are evaluated in the GALL Report.

Miscellaneous Building Ventilation and Cooling Systems

The miscellaneous building ventilation and cooling systems (MBVCS) consist of diesel generator building ventilation system, service water pumphouse ventilation system, safety-related chilled water system, service building ventilation system, substation relay house cooling system, penetration access area ventilation system, miscellaneous pump room systems and lube oil room system, and water treating area laboratory heating and cooling system. Heating, cooling, ventilation, and exhaust are provided by various MBVCS that maintain ambient air temperatures in the served areas between minimum and maximum levels suitable for personnel and equipment.

The service building ventilation system, substation relay house cooling system, penetration access areas ventilation system, miscellaneous pump room systems and lube oil room system, and water treating area laboratory heating and cooling system perform no safety function. The substation battery room exhaust fan in the substation relay house cooling system prevents the occurrence of any appreciable hydrogen concentration in the battery room.

The applicant evaluated component supports of the HVAC ductwork listed in LRA Table 3.5-1 for these nonsafety systems. The applicant performed a screening process on components that support the operation of these HVAC systems in LRA Section 2.1.2.1. The staff's scoping

review of SC supports is addressed in Section 2.1.2.2 of this SER. Electrical and I&C components in the HVAC systems are addressed in Section 2.1.2.3 of this SER.

The diesel generator building ventilation subsystem, service water pumphouse ventilation subsystem, and safety-related chilled water system of the MBVCS perform safety functions because loss of heat removal capability of any of these subsystems could result in failure of components credited for accident mitigation. Each of the subsystems is powered by separated Class 1E power supplies. Operation of the service water pumphouse ventilation system and the chilled water system are automatically initiated by receipt of a safety injection or loss of offsite power signal. Safety-related systems are monitored and alarms are annunciated in the control room. These subsystems are further discussed below.

Diesel Generator Building Ventilation Subsystem:

The diesel generator building ventilation subsystem is an ESF system. The main components of the system for each diesel room include two 50 percent-capacity ventilation fans to supply outside air to the diesel generator room, the diesel generator electric equipment room, and the diesel generator cable-pipe-basement area.

The fans of the system cycle and associated dampers open and close in response to room thermostats located in the diesel generator rooms and diesel generator electric equipment rooms when the diesel generators are not operating. Both fans associated with a diesel generator room start automatically and operate continuously whenever the diesel generator in that room operates. Ventilation air is drawn through roof openings which are shielded from external tornado missiles and forced into the diesel generator room by fans.

Service Water Pumphouse Ventilation Subsystem:

The service water pumphouse ventilation subsystem is an ESF system. The main components of the subsystem include two 100 percent-capacity ventilation supply fans that provide outside air to various areas of the service water pumphouse.

Either of the two supply fans operates continuously during normal operating periods. Both fans start automatically following receipt of a safety injection or loss of offsite power signal. The fans are powered from separate Class 1E power sources.

The license renewal boundaries for the MBVCS are depicted on the following P&ID drawings:

- D-912-134, Diesel Generator Areas System Flow Diagram
- D-912-155, Service Water Intake Screen/Pump House Bldg. Vent. System Flow Diagram

In LRA Section 2.3.3.1 and UFSAR Section 9.4.1, the applicant identified the following intended functions for the MBVCS:

- to provide safety-related function of heat removal capability inside the diesel generator rooms and diesel generator electric equipment rooms by maintaining these areas at acceptable ambient air temperatures between minimum and maximum levels suitable for personnel and equipment

- to provide safety-related function of heat removal capability inside the service water pump/screen room areas, related motor control center, and electrical switchgear rooms by maintaining these areas at acceptable ambient air temperatures between minimum and maximum levels suitable for personnel and equipment

In LRA Table 2.3-18, the applicant identified the component types for the MBVCS that are subject to an AMR. In LRA Tables 3.3-1 and 3.3-2, the applicant identified the component types and commodities groups (combinations of materials and environments) that are within the AMP and are evaluated in the GALL Report.

Reactor Building Cooling and Filtering Systems

The reactor building cooling and filtering systems (RBCFS) has the safety functions to (1) maintain the ambient air temperature at a suitable level for continuous operation of equipment within the building under normal operating and shutdown conditions, (2) provide cleanup of the reactor building atmosphere to minimize the release of radioactivity to the environment before purging, and (3) assist other heat removal systems during a post accident conditions.

The RBCFS consists of reactor building cooling system, reactor building purge supply and exhaust system, post accident hydrogen removal and alternate reactor building purge system, reactor building charcoal cleanup system, reactor building reactor compartment and cooling system, reactor building secondary compartment cooling system, reactor building refueling water surface system and rod position indication cooling system, reactor building CRDM shroud cooling system, and reactor building elevator machine room system. These systems are further described below.

Reactor Building Cooling System:

The two cooling units powered from channel-A of the Class 1E electric system are located on the opposite side of the reactor building from the two cooling units supplied from channel-B. Also the cooling water supply and return mains to these units are physically separated as is the A and B channel wiring. Each unit can operate independently of the others and the discharge from each unit is isolated from the common air supply main by gravity operated dampers. Reactor building cooling system components that must remain intact following a LOCA include four plenums and all internal components, plenum discharge ducts, common air supply main, and six vertical supply ducts from the common air supply main to the lower elevation of the reactor building. The components noted above are designed to remain intact following a LOCA.

Each plenum includes moisture separators, HEPA filters, filter bypass opening and dampers, cooling coils, and an axial flow fan driven by separate high speed and slow speed motors.

The reactor building cooling unit fans operate at high speed during normal periods, and at slow speeds during post LOCA periods and reactor building leak rate testing. The units are serviced by cooling water from the industrial cooling system during normal operation and by service water system during post LOCA or loss of offsite power conditions. For normal operation, three out of four fans operate. For LOCA, one fan in each train operates.

The units, when operating in the normal mode, are tripped upon the receipt of a safety injection or loss of offsite power signal, and are then automatically started at slow speed in accordance with the ESF actuation system and the ESF loading sequence of the related emergency diesel generator.

The reactor building cooling units can be manually operated from the control room at either high or slow speed. In response to an ESF loading sequence signal, the unit speed selector switches in the control room can determine which one of 2A and one of 2B electrical power channel starts. The plenum unit HEPA filter bypass damper is in the open position during normal operation and is automatically closed upon receipt of a safety injection signal.

Reactor Building Purge Supply and Exhaust System:

Containment isolation is safeguarded through the use of redundant, fail closed, butterfly valves on both the purge supply and exhaust lines. Electrical interlocks allow no more than one valve of a redundant pair of containment isolation valves to be open unless the exhaust system is operating (one valve of the pair can be open for testing purposes). Automatic closure of the four containment isolation valves of this system occurs upon receipt of a containment isolation signal or a high radiation signal. These measures, combined with administrative control of system operation, ensure that containment air is not released to the atmosphere through uncontrolled paths. The purge supply and exhaust system are not required to operate during a post accident period. The purge supply and exhaust isolation valves, as noted above, isolate the containment and are redundant safety-related equipment.

Alternate Reactor Building Purge System:

Containment isolation is assured through the use of redundant, fail closed, gate valves on both the alternate purge supply and exhaust lines. Automatic closure of the four containment isolation valves in the alternate reactor building purge system occurs upon receipt of a containment isolation signal or a high radiation signal. These measures, combined with administrative control of system operation, ensure that containment air is not released to the atmosphere through uncontrolled paths. The alternate reactor building purge system containment isolation valves and accessories are safety-related.

Reactor Building Charcoal Cleanup System:

Redundancy of the reactor building cleanup units provides iodine removal capability even if one of the units is not available. This condition extends the required cleanup time prior to purging, but does not prevent eventual completion of system function. This system is not required to operate under accident conditions and is not supplied from emergency power sources. The system is not safety-related.

Reactor Building Reactor Compartment Cooling System, Secondary Compartment Cooling System, and CRDM Shroud Cooling System:

For each of the three systems, adequate redundancy of system components is provided to ensure that sufficient cooling capacity is delivered under varying conditions of component availability. These systems are not required to operate under accident conditions and are not safety-related.

Reactor Building Elevator Machine Room System:

The reactor building elevator machine room ventilation system operates in response to the room thermostat. The system has no post-accident safety function and is not safety-related.

The license renewal boundaries for the RBCFS are depicted on the following P&ID drawings:

- D-806-102, RB Cooling System Flow Diagram
- D-912-103, RB Purge Supply and Purge Exhaust Systems Flow Diagram
- D-912-105, RB Refueling Water Surface System Flow Diagram

In LRA Section 2.3.3.1 and UFSAR Section 9.4.1, the applicant identified the following intended functions for the RBCFS:

- to maintain an average reactor building air temperature below a maximum of 120 °F during normal power operation as assumed in the accident analyses and below 100 °F during refueling operations for personnel comfort and safety

- to maintain an average reactor building air temperature above 60 °F during shutdown conditions for personnel comfort and safety

- to provide forced air cooling in sufficient capacity to remove CRDM heat and reject it to the general reactor building atmosphere

- to provide reactor building cleanup capacity to reduce airborne radioiodine levels prior to personnel entry and to minimize radioactivity released during reactor building purging

In LRA Table 2.3-18, the applicant identified the component types for the RBCFS that are subject to an AMR. In LRA Tables 3.3-1 and 3.3-2, the applicant identified the component types and commodities groups (combinations of materials and environments) that are within the AMP and are evaluated in the GALL Report.

2.3.3.1.2 Staff Evaluation

<u>Control Building Area Ventilation System</u>

The staff reviewed LRA Section 2.3.3.1 and UFSAR Section 9.4.1 to determine whether the CBAVS components are within the scope of license renewal in accordance with 10 CFR 54.4 and are subject to an AMR in accordance with the requirements of 10 CFR 54.4 and 10 CFR 54.21(a)(1), respectively. The staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

In the performance of this review, the staff selected system functions described in the UFSAR that were set forth in 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of the license renewal Rule. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted.

During its review, the staff determined that additional information was needed to complete its review. In a letter dated March 28, 2003, the staff asked the applicant in RAIs 2.3.3.1-1 and

2.3.3.1-4 why the system damper and filter housings and their intended functions are not listed in LRA Table 2.3-18. Also, in RAI 2.3.3.1-6, the staff asked whether the instrument housings and their associated tubing are subject to an AMR. By letter dated June 12, 2003, the applicant stated that the CBAVS damper and filter housings, and instrument housings and their associated tubing, are subject to an AMR if they are in scope (if they are in the pressure boundary of a system). The license renewal boundaries of these damper housings are highlighted on the P&ID drawings and are included with ductwork in the application (Table 3.3-2, Item 2 for stainless steel and Item 3 for carbon and galvanized steel, provides more description). The filter housings (with a license renewal intended function) are highlighted on the P&ID drawings and are included in LRA Table 2.3-18 (in the groups of ductwork, fan, and plenum housings). The applicant further clarified that the CBAVS instruments and instrument tubing in scope are highlighted on the applicable P&ID drawings, and instrument tubing is listed in LRA Table 2.3-18. However, the instruments are active components and are not listed in LRA Table 2.3-18 for an AMR .

The staff reviewed the applicant's response and found it acceptable concerning the CBAVS housings for dampers, filters and instruments, and associated instrument tubings because it clarified the pertinent information on the system components that are within the scope of license renewal, as required by 10 CFR 54.21(a)(1).

The staff also asked the applicant, in RAI 2.3.3.1-2, to clarify whether ductwork turning vanes, ventilation system elastomer seals, ventilation equipment vibration isolator flexible connections, ductwork test connections, and ductwork access doors are within the scope of license renewal and subject to an AMR. By letter dated June 12, 2003, the applicant provided the following clarification for the CBAVS components:

- ductwork turning vanes are part of the subcomponent of the ductwork and are made of the same material as the ductwork (galvanized steel or stainless steel) and are bounded by the AMP for the ductwork

- flexible seals between duct and housings are in scope and included in LRA Table 2.3-18, and its AMP is described in LRA Table 3.3-1, Item 2. However, door seals are considered as consumables that do not perform an intended function as a pressure boundary and are not subject to an AMR

- ductwork flexible connections are in scope and are listed in LRA Table 2.3-18 (its AMP is described in LRA Table 3.3-1, Item 2). The components with "vibration isolator flexible connections" are not within the scope of license renewal

- ductwork test connections and ductwork access doors are considered part of the ductwork and are included in that component group in LRA Tables 2.3-18, 3.3-1 and 3.3-2. Ductwork test connections are typically holes that are normally filled with a "push penny." The push penny is not required for the system to meet its license renewal intended function

The staff reviewed the applicant's response and found it acceptable because it clarified the pertinent information on the CBAVS components that are within the scope of license renewal and subject to an AMR, as required by 10 CFR 54.21(a)(1).

Additionally, the staff also asked the applicant, in RAIs 2.3.3.1-3 and 2.3.3.1-7, to clarify whether structural sealants used to maintain the pressure boundary of the main control room envelope at design pressure, with respect to the adjacent areas, are within the scope of license renewal and subject to an AMR. The staff also requested the applicant to provide information relating to structural sealants as referenced in Table 2.1-3 (on page 2.1-15) of NUREG 1800.

By letter dated June 12, 2003, the applicant provided the following clarification for the CBAVS components:

- the applicant's position on consumables is consistent with NUREG-1800, Table 2.1-3. Packing, gaskets, component seals, and O-rings are subcomponents of structural components that are excluded from an AMR for several reasons. ASME code indicates that gaskets, packing, and O-rings do not serve as pressure boundaries and are therefore excluded from an AMR. Seal material on components, such as doors, do not perform system intended function. They are replaced periodically based on testing results and are not subject to an AMR. Seals and O-rings for structural components are not treated individually, but rather as parts of their host components (doors, airlocks, hatches, etc.) which are managed under the AMPs and plant procedures. Oil, grease, and component filters are short-lived with periodic replacement and are excluded from an AMR. System filters, fire extinguishers, fire hoses, and air packs are discussed in LRA Section 2.1.2.1.4:

- The terminology of "structural sealants" as identified in RAI 2.3.3.1-3 and NUREG-1800 is not used at the plant. However, structural sealants would include fire door seals and coatings, pressure seals, expansion joints, etc., all of which are addressed in the LRA. The applicant recognizes that locations exist where these materials or component types are important in maintaining the integrity of the component to which they are connected. For these situations, the license renewal, or component intended function supported by the sealant, is to maintain the building pressure boundary envelope. The pressure boundary function is addressed by surveillance testing to demonstrate compliance with technical specifications.

- These structural sealant materials (i.e., expansion joints, caulking, seals, etc.) discussed above are considered to be consumables. Various inspection programs, as addressed in the LRA (B.1.5, B.1.11, B.1.12, B.1.16, B.1.18, and B.1.20), will determine their replacement. The life of these materials is based on identification of wear or damage during these inspections. Programmatic actions are not to manage their life, but rather to replace them when their conditions are no longer acceptable for service. These materials are subject to periodic replacement and, therefore, are not subject to an AMR, as required by 10 CFR 54.21(a)(1).

The staff reviewed the applicant's response and found it acceptable because it clarified the pertinent information on the CBAVS components that are within the scope of license renewal and subject to an AMR.

<u>Auxiliary and Radwaste Area Ventilation System</u>

The staff reviewed LRA Section 2.3.3.1 and UFSAR Section 9..4.2 to determine whether the ARAVS components within the scope of license renewal and subject to an AMR have been

identified in accordance with 10 CFR 54.4 and 54.21(a)(1). The staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

In the performance of the review, the staff selected system functions described in the UFSAR that were set forth in 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of the license renewal Rule. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted.

During its review, the staff determined that additional information was needed to complete its review. In a letter dated March 28, 2003, the staff asked the applicant, in RAIs 2.3.3.1-1 and 2.3.3.1-4, why the system damper housings and their intended functions are not listed in LRA Table 2.3-18 for an AMR. The staff also asked the applicant, in RAI 2.3.3.1-6, whether the instrument housings and their associated tubing are subject to an AMR. By letter dated June 12, 2003, the applicant stated that the ARAVS damper housings are considered subject to an AMR if they are in the portion (pressure boundary) of a system that is in scope. These damper housings are highlighted on the license renewal boundary drawings and are included with ductwork in the application (Table 3.3-2, Item 2 for stainless steel and Item 3 for carbon and galvanized steel, provides more description). The applicant clarified that the ARAVS instruments and instrument tubing are highlighted on the applicable license renewal boundary drawings, and the instrument tubing within the scope of license renewal is listed in Table 2.3-18. However, the instruments are active components and are not subject to an AMR.

The staff reviewed the applicant's response and found it acceptable concerning the ARAVS housings for dampers, instruments, and associated instrument tubings because it clarified the pertinent information on the ARAVS components that are within the scope of license renewal and subject to an AMR.

The staff also asked the applicant, in RAI 2.3.3.1-2, to clarify whether ductwork turning vanes, ventilation system elastomer seals, ventilation equipment vibration isolator flexible connections, ductwork test connections, and ductwork access doors are within the scope of license renewal and subject to an AMR. By letter dated June 12, 2003, the applicant provided the following clarification for the ARAVS components:

- ductwork turning vanes are the subcomponents of the ductwork that are made of the same material as the ductwork (galvanized steel or stainless steel) and are bounded by the AMP

- flexible seals between the duct and housings are in scope and are listed in LRA Table 2.3-18. Its AMP is described in LRA Table 3.3-1, Item 2. However, door seals are considered consumables that do not perform an intended function as a pressure boundary and, therefore, are not subject to an AMR

- ductwork flexible connections are in scope and are listed in LRA Table 2.3-18 (its AMP is described in LRA Table 3.3-1, Item 2). The components with "vibration isolator flexible connections" are not within the scope of license renewal

- ductwork test connections and ductwork access doors are part of the ductwork that are included in LRA Tables 2.3-18, 3.3-1, and 3.3-2 as ductwork. The ductwork test

connections are typically holes that are normally filled with a "push penny." The push penny is not required for the system to perform its license renewal intended function

The staff reviewed the applicant's response and found it acceptable because it clarified the pertinent information on the ARAVS components that are within the scope of license renewal and subject to an AMR, as required by 10 CFR 54.21(a)(1).

Additionally, the staff also asked the applicant, in RAIs 2.3.3.1-3 and 2.3.3.1-7, to clarify whether structural sealants used to maintain the pressure boundary at design pressure with respect to the adjacent areas are within the scope of license renewal and subject to an AMR. Also, the staff requested the applicant to provide information relating to structural sealants as referenced in Table 2.1-3 (on page 2.1-15) of NUREG-1800.

By letter dated June 12, 2003, the applicant provided the following clarification for the ARAVS components:

- The applicant's position on consumables is consistent with NUREG-1800, Table 2.1-3. Packing, gaskets, component seals, and O-rings are subcomponents of structural components that are excluded from AMR for several reasons. ASME code indicates that gasket, packing and O-rings are not served as pressure boundary components and, therefore, are excluded from an AMR . Seal material on components, such as doors, does not perform an intended function and is replaced periodically based on testing results and, therefore, is not subject to an AMR . Seals and O-rings for structural components are not treated individually as consumables, but rather as parts of their host components (doors, airlocks, hatches, etc.) which are managed under the AMPs and plant procedures. Oil, grease, and component filters are short lived with periodic replacement and are excluded from an AMR. System filters, fire extinguishers, fire hoses, and air packs are discussed in LRA Section 2.1.2.1.4

- The terminology of "structural sealants" as identified in an RAI 2.3.3.1-3 and NUREG-1800 is not used at the plant. However, structural sealants would include fire door seals and coatings, pressure seals, expansion joints, etc., all of which are addressed in the LRA. These materials or component types are important in maintaining the integrity of the components to which they are connected. For these situations, the license renewal, or component intended function supported by the sealant, is to maintain the building pressure boundary envelope. The pressure boundary function of these materials is determined by surveillance testing to demonstrate compliance with technical specifications

- These structural sealant materials (expansion joints, caulking, seals, etc.) discussed above are considered to be consumables. Various inspection programs as addressed in the LRA (i.e., B.1.5, B.1.11, B.1.12, B.1.16, B.1.18, and B.1.20) will determine their replacement. The life of these materials is determined based on wear or damage identified during inspections. Programmatic actions are not to manage their life, but rather to replace them when their condition indicates that they are no longer acceptable for service. Therefore, these materials are replaced based on condition monitoring and are not subject to an AMR, as required by 10 CFR 54.21(a)(1).

The staff reviewed the applicant’s response and found it acceptable because it clarified the pertinent information on the ARAVS components that are within the scope of license renewal and subject to an AMR, as required by 10 CFR 54.21(a)(1).

Fuel Handling Building Ventilation

The staff reviewed LRA Section 2.3.3.1 and UFSAR Section 9.4.3 to determine whether the FHBV components within the scope of license renewal and subject to an AMR have been identified in accordance with 10 CFR 54.4 and 54.21(a)(1). The staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described as below.

In the performance of the review, the staff selected system functions described in the UFSAR that were set forth in 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of the license renewal Rule. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted.

During its review, the staff determined that additional information was needed to complete its review. In a letter dated March 28, 2003, the staff asked the applicant, in RAIs 2.3.3.1-1 and 2.3.3.1-4, why the system damper and filter housings and their intended functions are not listed in LRA Table 2.3-18. Also, the staff ask the applicant, in RAI 2.3.3.1-6, whether the instrument housings and their associated tubing are subject to an AMR. By letter dated June 12, 2003, the applicant stated that the FHBV damper, filter housings, and filter are considered subject to an AMR if they are in the portion (pressure boundary) of a system that is in scope. These damper housings are highlighted on the license renewal boundary drawings with ductwork in the application (Table 3.3-2, Item 2 for stainless steel and Item 3 for carbon and galvanized steel, provides more description). The filter housings (with a license renewal intended function) are highlighted on the license renewal boundary drawings and are listed in Table 2.3-18 (in the component groups of ductwork, fan, and plenum housings). The applicant clarified that FHBV instruments and instrument tubing considered in scope are highlighted on the applicable P&ID drawings, and the instrument tubing is listed in Table 2.3-18. However, the instruments are active components and are not subject to an AMR.

The staff reviewed the applicant’s response and found it acceptable concerning the FHBV housings for dampers, filters and instruments, and associated instrument tubings because it clarified the pertinent information on the system components that are within the scope of license renewal and subject to an AMR, as required by 10 CFR 54.21(a)(1).

The staff also asked the applicant, in RAI 2.3.3.1-2, to clarify whether ductwork turning vanes, ventilation system elastomer seals, ventilation equipment vibration isolator flexible connections, ductwork test connections, and ductwork access doors are within the scope of license renewal and subject to an AMR. By letter dated June 12, 2003, the applicant provided clarification for the FHBV components as follows:

- Ductwork turning vanes are part of the subcomponent of the ductwork that are made of the same material as the ductwork (galvanized steel or stainless steel) and are bounded by the AMP for the ductwork

- Flexible seals between duct and housings are in scope and are listed in LRA Table 2.3-18. Its AMP is described in LRA Table 3.3-1, Item 2. However, door seals are considered as consumables that do not perform an intended function as pressure boundary and are not subject to an AMR

- Ductwork flexible connections are in scope and listed in LRA Table 2.3-18 (its AMP is described in LRA Table 3.3-1, Item 2). The plant does not mount in scope components with "vibration isolator flexible connections"

- Ductwork test connections and ductwork access doors are considered part of the ductwork and are included in that component group in LRA Tables 2.3-18, 3.3-1, and 3.3-2. Ductwork test connections are typically holes that are normally filled with a "push penny." The push penny is not required for the system to meet its license renewal intended function

The staff reviewed the applicant's response and found it acceptable because it clarified the pertinent information on the FHBV components that are within the scope of license renewal, as required by 10 CFR 54.4(a), and subject to an AMR, as required by 10 CFR 54.21(a)(1).

Additionally, the staff also asked the applicant, in RAIs 2.3.3.1-3 and 2.3.3.1-7, whether structural sealants used to maintain the pressure boundary of design pressure with respect to adjacent areas are within the scope of license renewal and subject to an AMR. Also, the staff requested the applicant to provide information related to structural sealants as referenced in Table 2.1 3 (on page 2.1-15) of NUREG-1800.

By letter dated June 12, 2003, the applicant provided the following clarification for the FHBV components:

- The applicant's position on consumables is consistent with NUREG-1800, Table 2.1-3. Packing, gaskets, component seals, and O-rings are subcomponents of structural components that are excluded from AMR for several reasons. ASME code indicates that gasket, packing, and O-rings are not relied on as pressure boundary components and are, therefore, excluded from an AMR. Seal material on components, such as doors, does not perform an intended function and is replaced periodically based on testing results, and is not subject to an AMR. Seals and O-rings for structural components are not treated individually as consumables, but rather as parts of their host components (doors, airlocks, hatches, etc.) which are managed under the AMPs and plant procedures. Oil, grease, and component filters are short-lived with periodic replacement and are excluded from an AMR. System filters, fire extinguishers, fire hoses, and air packs are discussed in LRA Section 2.1.2.1.4

- The terminology, "structural sealants," as identified in RAI 2.3.3.1-3 and NUREG-1800, is not used at the plant. However, structural sealants would include fire door seals and coatings, pressure seals, expansion joints, etc., all of which are addressed in the LRA. The applicant recognizes that locations exist where these materials or component types are important in maintaining the integrity of the component to which they are connected. In these situations, the license renewal or component intended function supported by the sealant is to maintain the building pressure boundary envelope. The pressure

boundary function is addressed by surveillance testing to demonstrate compliance with technical specifications

- These structural sealant materials (expansion joints, caulking, seals, etc.) discussed above are considered to be consumables. Various inspection programs addressed in the LRA (B.1.5, B.1.11, B.1.12, B.1.16, B.1.18, and B.1.20) will determine their replacement. The life of these materials is based on the extent of wear or damage identified during inspections. Programmatic actions are not to manage their life, but rather to replace them when their condition indicates that they are no longer acceptable for service. These materials are replaced based on condition monitoring and are not subject to an AMR

The staff reviewed the applicant's response and found it acceptable because it clarified the pertinent information on the FHBV components that are within the scope of license renewal and subject to an AMR, as required by 10 CFR 54.21(a)(1).

The staff also requested the applicant, in RAI 2.3.3.1-8, to clarify whether the FHBV exhaust ductwork is within the scope of license renewal and subject to an AMR. By letter dated June 12, 2003, the applicant stated that the FHBV exhaust ductwork downstream of the fans does not need to remain intact to perform its intended function. The FHBV's functions are to maintain a negative pressure in the fuel handling building, and remove airborne particulate and radioiodines during fuel handling activities and blackout conditions within acceptable limits. The pressure boundary of the ductwork downstream of the fans is located in the auxiliary building that does not perform this function. Some portion of this ductwork is in scope for spatial interaction concern that was included in a supplement submittal to the application. The staff found the applicant's response acceptable because it clarified the pertinent information on the FHBV exhaust ductwork that need not to be in the scope of license renewal.

<u>Intermediate Building Ventilation Systems</u>

The staff reviewed LRA Section 2.3.3.1 and UFSAR Section 9.4.6 to determine whether the IBVS components within the scope of license renewal and subject to an AMR have been identified in accordance with 10 CFR 54.4 and 54.21(a)(1), respectively. The staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

In the performance of the review, the staff selected system functions described in the UFSAR that were set forth in 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of the license renewal Rule. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted.

During its review, the staff determined that additional information was needed to complete its review. In a letter dated March 28, 2003, the staff asked the applicant, in RAI 2.3.3.1-6, whether the system instrument housings and their associated tubing are subject to an AMR. By letter dated June 12, 2003, the applicant stated that the IBVS instruments and their instrument tubing are subject to an AMR (if they are within the pressure boundary). The applicant further clarified that the IBVS instruments and instrument tubing in scope are highlighted on the applicable license renewal boundary drawings, and instrument tubing is listed in LRA Table 2.3-18. However, the instruments are active components and are not subject to an AMR.

The staff found the applicant's response acceptable concerning the instrument housings and associated instrument tubings because it clarified the pertinent information on the system components that are within the scope of license renewal, as required by 10 CFR 54.4(a), and subject to an AMR, as required by 10 CFR 54.21(a)(1).

The staff also requested the applicant, in RAI 2.3.3.1-2, to clarify whether ductwork turning vanes, ventilation system elastomer seals, ventilation equipment vibration isolator flexible connections, ductwork test connections, and ductwork access doors are within the scope of license renewal and subject to an AMR. By letter dated June 12, 2003, the applicant provided the following clarification for the IBVS components:

- Ductwork turning vanes are part of the subcomponent of ductwork and are made of the same material as the ductwork (galvanized steel or stainless steel) and are bounded by the AMP for the ductwork

- Flexible seals between duct and housing are in scope and included in LRA Table 2.3-18, and its AMP is described in LRA Table 3.3-1, Item 2. However, door seals are the consumables that do not perform an intended function as a pressure boundary and are not subject to an AMR

- Ductwork flexible connections are in scope and included in LRA Table 2.3-18 (its AMP is described in LRA Table 3.3-1, Item 2). The plant does not mount in scope components with "vibration isolator flexible connections"

- Ductwork test connections and ductwork access doors are considered part of the ductwork and are included in that component group in LRA Tables 2.3-18, 3.3-1, and 3.3-2. Ductwork test connections are typically holes that are normally filled with a "push penny." The push penny is not required for the system to perform its license renewal intended function

The staff reviewed the applicant's response and found it acceptable because it clarified the pertinent information on the IBVS components that are within the scope of license renewal and subject to an AMR, as required by 10 CFR 54.21(a)(1).

The staff also requested the applicant, in RAI 2.3.3.1-5, to clarify whether the IBVS used to support safe shutdown controls are within the scope of license renewal and subject to an AMR. By letter dated June 12, 2003, the applicant provided the following clarifications:

- The safe shutdown controls and panels at the plant are the control room evacuation panels (CREP). The CREP are located in the speed switch room area of the plant, and the cooling system for this area is shown on P&ID drawing D-912-157. The speed switch room area cooling system is within the scope of license renewal and subject to an AMR.

- Alternate or remote safe shutdown panels (requiring control room evacuation) is achieved using the train "B" equipment and controls by a variety of means, including controls at the CREP, controls at switchgear and motor control centers, and controls mounted on the local panels for the "B" diesel generator and "B" water chiller.

The staff reviewed the applicant's response and found it acceptable because it clarified the pertinent information on the CREP served by the IBVS and the speed switch room area cooling that is within the scope of license renewal and subject to an AMR.

Miscellaneous Building Ventilation and Cooling Systems

The staff reviewed LRA Section 2.3.3.1 and UFSAR Section 9.4.7 to determine whether the MBVCS components within the scope of license renewal and subject to an AMR have been identified in accordance with 10 CFR 54.4 and 54.21(a)(1), respectively. The staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

During its review, the staff determined that additional information was needed to complete its review. In a letter dated March 28, 2003, the staff asked the applicant, in RAI 2.3.3.1-6, whether the system instrument housings and their associated tubing are subject to an AMR. By letter dated June 12, 2003, the applicant stated that MBVCS instruments and instrument tubing are in scope. They are highlighted on the applicable license renewal boundary drawings and the instrument tubing is listed in LRA Table 2.3-18. However, the instruments are active components and are not listed in the table.

The staff reviewed the applicant's response and found it acceptable concerning the instrument housings and associated instrument tubings because it clarified the pertinent information on the MBVCS components that are within the scope of license renewal and subject to an AMR, as required by 10 CFR 54.21(a)(1).

The staff also requested the applicant, in RAI 2.3.3.1-2, to clarify whether ductwork turning vanes, ventilation system elastomer seals, ventilation equipment vibration isolator flexible connections, ductwork test connections, and ductwork access doors are within the scope of license renewal and subject to an AMR. By letter dated June 12, 2003, the applicant provided the following clarification for the MBVCS components:

- Ductwork turning vanes are part of the subcomponent of the ductwork and are made of the same material as the ductwork (galvanized steel or stainless steel) and are bounded by the AMP for the ductwork

- Flexible seals between duct and housings are in scope and are listed in LRA Table 2.3-18, and its AMP is described in LRA Table 3.3-1, Item 2. However, door seals are considered as consumables that do not perform an intended function as pressure boundary and, therefore, are not subject to an AMR

- Ductwork flexible connections are in scope and are listed in LRA Table 2.3-18 (its AMP is described in LRA Table 3.3-1, Item 2). The plant does not mount in scope components with "vibration isolator flexible connections."

- Ductwork test connections and ductwork access doors are considered part of the ductwork and are included in that component group in LRA Tables 2.3-18, 3.3-1, and 3.3-2. Ductwork test connections are typically holes that are normally filled with a "push penny." The push penny is not required for the system to perform its intended function.

The staff reviewed the applicant's response and found it acceptable because it clarified the pertinent information on the MBVCS components that are within the scope of license renewal and subject to an AMR, as required by 10 CFR 54.21(a)(1).

Reactor Building Cooling and Filtering Systems

The staff reviewed LRA Section 2.3.3.1 and UFSAR Section 9.4.8 to determine whether the RBCFS components within the scope of license renewal and subject to an AMR have been identified, in accordance with 10 CFR 54.4 and 54.21(a)(1), respectively. The staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

In the performance of the review, the staff selected system functions described in the UFSAR that were set forth in 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of the license renewal Rule. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted.

During its review, the staff determined that additional information was needed to complete its review. The staff asked the applicant, in RAIs 2.3.3.1-1 and 2.3.3.1-4, why the system damper and filter housings and their intended functions are not listed in LRA Table 2.3-18. The staff also asked the applicant, in RAI 2.3.3.1-6, whether the instrument housings and their associated tubing are subject to an AMR. By letter dated June 12, 2003, the applicant stated that the RBCFS damper and filter housings and filter are subject to an AMR if they are within the pressure boundary of a system which is in scope. The damper housings are highlighted on the applicable license renewal boundary drawings and are with the ductwork in scope (Table 3.3-2, Item 2 for stainless steel and Item 3 for carbon and galvanized steel, provides more description). The filter housings are highlighted on the license renewal boundary drawings and are included in Table 2.3-18 (in the groups of ductwork, fan, and plenum housings). Also, the RBCFS instruments and instrument tubing in scope are highlighted on the applicable license renewal boundary drawings and the instrument tubing is listed in Table 2.3-18. However, the instruments are active components and are not listed in the table.

The staff reviewed the applicant's response and found it acceptable concerning the RBCFS housings for dampers, filters, and instruments, and associated instrument tubings because it clarified the pertinent information on the system components that are within the scope of license renewal and subject to an AMR, as required by 10 CFR 54.21(a)(1).

The staff also asked the applicant, in RAI 2.3.3.1-2, whether ductwork turning vanes, ventilation system elastomer seals, ventilation equipment vibration isolator flexible connections, ductwork test connections, and ductwork access doors are within the scope of license renewal and subject to an AMR. By letter dated June 12, 2003, the applicant provided the following clarification for the RBCFS components:

- Ductwork turning vanes are part of the subcomponent of the ductwork that are made of same material as the ductwork (galvanized steel or stainless steel) and are bounded by the AMP for the ductwork.

- Flexible seals between duct and housings are in scope and are listed in Table 2.3-18. Its AMP is described in LRA Table 3.3-1, Item 2. However, door seals are considered

as consumables that do not perform an intended function as a pressure boundary and, therefore, are not subject to an AMR.

- Ductwork flexible connections are in scope and are listed in Table 2.3-18. Its AMP is described in LRA Table 3.3-1, Item 2). The plant does not mount in scope components with "vibration isolator flexible connections."

- Ductwork test connections and ductwork access doors are considered part of the ductwork and are included in that component group in LRA Tables 2.3-18, 3.3-1, and 3.3-2. Ductwork test connections are typically holes that are normally filled with a "push penny." The push penny is not required for the system to meet its license renewal intended function.

The staff reviewed the applicant's response and found it acceptable because it clarified the pertinent information on the RBCFS components that are within the scope of license renewal and subject to an AMR, as required by 10 CFR 54.21(a)(1).

Additionally, the staff also asked the applicant, in RAIs 2.3.3.1-3 and 2.3.3.1-7, whether structural sealants used to maintain the pressure boundary at design pressure with respect to the adjacent areas are included in the scope of license renewal and subject to an AMR. The staff also requested the applicant to provide information relating to structural sealants as referenced in Table 2.1-3 (on page 2.1- 15) of NUREG 1800.

By letter dated June 12, 2003, the applicant provided the following clarification for the RBCFS components:

- The applicant's position on consumables is consistent with NUREG-1800, Table 2.1-3. Packing, gaskets, component seals, and O-rings are the subcomponents of structural components that are excluded from AMR for several reasons. ASME code indicates that gaskets, packing, and O-rings are not pressure boundary components and are not subject to an AMR. Seal material on components, such as doors, does not perform system's intended function and is periodically replaced based on testing results, and, therefore, is not subject to an AMR. Seals and O-rings for structural components are not treated individually as consumables, but rather as parts of their host components (doors, airlocks, hatches, etc.) which are managed under the AMPs and plant procedures. Oil, grease, and component filters are short-lived with periodic replacement and are excluded from an AMR. System filters, fire extinguishers, fire hoses, and air packs, are discussed in LRA Section 2.1.2.1.4.

- The terminology of "structural sealants" as identified in RAI 2.3.3.1-3 and NUREG-1800 is not used at the plant. However, structural sealants would include fire door seals and coatings, pressure seals, expansion joints, etc., all of which are addressed in the LRA. The applicant recognizes that locations exist where these materials or component types are important in maintaining the integrity of the component to which they are connected. For these situations, the license renewal or component intended function supported by the sealant is to maintain the building envelope pressure boundary. The pressure boundary function is checked by surveillance testing to demonstrate compliance with technical specifications.

- These structural sealant materials (expansion joints, caulking, seals, etc.) discussed above are the consumables. Various inspection programs as addressed in the LRA (i.e., B.1.5, B.1.11, B.1.12, B.1.16, B.1.18, and B.1.20) determine their replacement. The life of these materials is based on the extent of wear or damage determined by inspections. Programmatic actions are not to manage their life, rather to replace them when their conditions are no longer acceptable for service. Therefore, these materials are replaced based on condition monitoring and do not require an AMR.

The staff found the applicant's response acceptable because it clarified the pertinent information on the RBCFS components that are within the scope of license renewal and subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.1.3 Conclusions

The staff reviewed the LRA and the accompanying scoping boundary drawings to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. No omissions were found. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. No omissions were found. On the basis of this review, the staff concludes that the applicant has adequately identified the components of the air handling and local ventilation and cooling systems that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has adequately identified the components of the air handling and local ventilation and cooling systems that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.2 Boron Recycle System

The applicant describes the boron recycle system in LRA Section 2.3.3.2 and provides a list of components subject to an AMR, along with their component intended functions, in LRA Table 2.3-19. The license renewal evaluation boundaries for the boron recycle system are depicted in the E-302-751 boron recycle drawing and in the 1MS-09-269 Flow Diagram — Recycle Evaporating Package. UFSAR Section 9.3.6, Boron Recycle System, provides additional information concerning the boron recycle system.

2.3.3.2.1 Summary of Technical Information in the Application

The boron recycle system collects recycled reactor coolant effluent for reuse of the boric acid and makeup water. For the most part, this effluent is water from the letdown and drains. The boron recycle system is designed to collect, via the letdown line in the chemical and volume control system, the excess reactor coolant that results from certain plant operations during a core cycle. The boron recycle system also collects water from the reactor coolant drain tank (liquid waste processing system), the volume control tank and charging pump suction pressure reliefs (chemical and volume control system) and residual heat removal pumps pressure reliefs (emergency core cooling system), the boric acid blender (chemical and volume control system), the spent fuel pool pumps (spent fuel cooling system), and various valve leakoffs and equipment drains. The boron recycle system is designed to process the total volume of water collected during a core cycle, as well as short-term surges.

When water is directed to the boron recycle system, the flow passes first through the recycle evaporator feed demineralizers and filters, and then into the recycle holdup tanks. When

sufficient water is accumulated to warrant evaporator operation, the recycle evaporator feed pumps take suction from the selected recycle holdup tank and pumps the fluid through the recycle evaporator, where dissolved gases (i.e., hydrogen, fission gases, and other gases) are removed in the stripping column before the liquid enters the evaporator shell. These gases are directed to the gaseous waste processing system.

The evaporator concentrates the boric acid solution until a 4-weight percent solution is obtained. The accumulated batch is normally transferred directly to the boric acid tanks in the chemical and volume control system through the recycle evaporator concentrates filter.

In this way, the system decontaminates the effluent by means of demineralization and gas stripping, and uses evaporation to separate and recover the boric acid and makeup water. The mechanical license renewal function of the boron recycle system is to maintain its system boundary with the component cooling and chemical and volume control systems.

The boron recycle system mechanical component types, listed in Table 2.3-19, consist of condenser channel heads, condenser tubes, condenser tubesheets, heat exchanger shells, heat exchanger shell nozzles, heat exchanger tubes, exchanger tubesheets, heat exchanger manifolds, and heat exchanger valve bodies. All of the listed components serve a pressure-retaining boundary function.

2.3.3.2.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.2 and UFSAR Section 9.3.6, Boron Recycle System, to determine whether the boron recycle system components and supporting structures within the scope of license renewal and subject to an AMR had been identified in accordance with the requirements of 10 CFR 54.4 and 10 CFR 54.21(a)(1), respectively. The staff review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

As part of the evaluation, the staff determined whether the applicant had properly identified the SSCs within the scope of license renewal and subject to an AMR, pursuant to 10 CFR 54.4(a) and 10 CFR 54.21(a)(1). The staff reviewed the relevant portions of the UFSAR for the boron recycle system and associated pressure boundary components, and compared the information in the UFSAR with the information in the LRA to identify those portions that the LRA did not identify as being within the scope of license renewal and subject to an AMR. The staff then reviewed the SCs that were identified as not being within the scope of license renewal to verify that these SCs do not have any of the intended functions delineated under 10 CFR 54.4(a), and for those SCs that have an applicable intended function(s), to verify that they either perform this function(s) with moving parts or a change in configuration or properties, or that they are subject to replacement based on a qualified life or specified time period, as described in 10 CFR 54.21(a)(1).

The staff also reviewed the UFSAR for any function(s) delineated under 10 CFR 54.4 (a) that were not identified as intended function(s) in the LRA, to verify that the SSCs with such function(s) will be adequately managed so that the function(s) will be maintained consistent with the CLB for the period of extended operation.

The principal area of review, for the boron recycle system, was to verify that all components in the pressure-retaining boundary with the component cooling and chemical and volume control systems have been included in the license renewal scope.

No omissions of SSCs that are within the scope of license renewal and subject to an AMR were found.

2.3.3.2.3 Conclusions

The staff reviewed LRA Section 2.3.3.2 and UFSAR Section 9.3.6, Boron Recycle System, to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. No omissions were found. On this basis, the staff concludes that the applicant has adequately identified the boron recycle system components that are within the scope of license renewal as required by 10 CFR 54.4(a) and that the applicant has adequately identified the boron recycle system components that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.3 Building Services

2.3.3.3.1 Summary of Technical Information in the Application

The applicant describes the building services system (BSS) in LRA Section 2.3.3.3, Building Services, and provides a list of components subject to an AMR in LRA Table 2.3-20. The system is further described in UFSAR Section 9.3.1, Compressed Air Systems.

The BSS provides means for structural integrity of various buildings on site. However, some of the components of the BSS are mechanical components that are used to maintain a pressure boundary for containment integrity, and their intended function is to provide containment isolation. These components include valves, tubing, and piping in the station service air system which supplies compressed air for the reactor building personnel, emergency personnel, and equipment hatches. The BSS license renewal boundaries are highlighted on P&ID drawing D-302-242, "Station Air Supply to Personnel, Emergency Personnel and Equipment Hatches."

2.3.3.3.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.3, the applicable portions of UFSAR Section 9.3.1, and the P&ID drawing to determine whether the BSS components within the scope of license renewal and subject to an AMR had been identified, in accordance with the requirements of 10 CFR 54.4(a) and 10 CFR 54.21(a)(1), respectively. The staff's review was conducted based on Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

During the review, the staff selected system functions described in the UFSAR that were set forth in 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of the Rule. The staff reviewed the components listed in LRA Table 2.3-20 and verified them with the P&ID drawing to ensure that components having intended functions were not omitted from an AMR. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted. The staff found that the BSS components that have an intended function meeting the criteria of 10 CFR 54.4(a), have

been identified as being within the scope of license renewal and subject to an AMR, in accordance with the requirements of 10 CFR 54.21(a)(1). As a result of this review, the staff did not identify any omissions.

2.3.3.3.3 Conclusions

The staff reviewed the LRA, UFSAR, and the accompanying license renewal boundary drawings to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. No omissions were found. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. No omissions were found. On the basis of this review, the staff concludes that the applicant has adequately identified the BSS components that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has appropriately identified the BSS components that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.4 Chilled Water System

2.3.3.4.1 Summary of Technical Information in the Application

The applicant describes the chilled water system in LRA Section 2.3.3.4, Chilled Water System, and provides a list of components subject to an AMR in LRA Table 2.3-21. The system is further described in UFSAR Section 9.4.7, Miscellaneous Building Ventilation and Cooling System.

The chilled water system provides cooling to various ventilation fan cooling units in different areas of the plant. The chilled water system is a closed system with redundant supply and return mains. Chiller condenser cooling water is supplied by the service water system. The chilled water system license renewal boundaries are highlighted on the following P&ID drawings:

- D-302-222, Service Water System
- D-302-841, Chilled Water Pump and Chiller Area
- D-302-842, Chilled Water to Cooling Coils
- D-302-843, Chilled Water to Cooling Coils
- 1MS-54-064-2, VU Mechanical Chillers

2.3.3.4.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.4, the applicable portions of UFSAR Section 9.4.7, and the P&ID drawings to determine whether the chilled water system components within the scope of license renewal and subject to an AMR had been identified in accordance with the requirements of 10 CFR 54.4 and 10 CFR 54.21(a)(1), respectively. The staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described as below.

During the review, the staff reviewed the components listed in LRA Table 2.3-21 and verified them with the P&ID drawings to ensure that components having intended functions were not omitted from the scope of license renewal. The staff also focused on components that were not

identified as being subject to an AMR to determine if any components were omitted. The staff found that the components of the chilled water system that have an intended function meeting the criteria of 10 CFR 54.4(a) have been identified as being within the scope of license renewal and subject to an AMR, in accordance with the requirements of 10 CFR 54.21(a)(1). As a result of this review, the staff did not identify any omissions.

2.3.3.4.3 Conclusions

The staff reviewed the LRA, the UFSAR, and the accompanying P&ID drawings to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. No omissions were found. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. No omissions were found. On the basis of this review, the staff concludes that the applicant has adequately identified the components of the chilled water system that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has appropriately identified the chilled water system components that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.5 Circulating Water System

2.3.3.5.1 Summary of Technical Information in the Application

The applicant describes the circulating water system (CWS) in LRA Section 2.3.3.5. The CWS is further described in UFSAR Section 10.4.5, Circulating Water System.

The CWS removes thermal energy from the main and auxiliary condensers and dissipates this energy to the Monticello Reservoir. The CWS is a non-safety-related cooling system and is not required to function under plant emergency or faulted conditions. The only license renewal intended function of the CWS is to provide level instruments that will trip the CWS pumps and close several CWS valves to prevent flooding in the intermediate building and control building as a result of pipe break in the CWS. There are no mechanical components required for the CWS to perform its system intended function and, therefore, no AMR for the mechanical components is required. Since instrumentation and controls are not required to be highlighted on the flow diagrams as within license renewal boundaries, P&ID drawings were not provided in the LRA to highlight the CWS license renewal boundaries.

2.3.3.5.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.5 and UFSAR Section 10.4.5 to determine whether the CWS components within the scope of license renewal and subject to an AMR had been identified in accordance with the requirements of 10 CFR 54.4 and 10 CFR 54.21(a)(1), respectively. The staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

As described above, the only license renewal function of the CWS is to provide level instruments that trip the CWS pumps and close several CWS valves to prevent the intermediate building and control building from flooding in the event of a pipe break in the CWS. Therefore, the applicant did not provide P&ID drawings in the LRA to highlight the license renewal boundaries for the CWS. During its review of LRA Section 2.3.3.5, the staff determined that

additional information regarding level instrumentations was needed to complete this review. By letter dated March 28, 2003, in RAI 2.3.3.5-1, the staff requested that the applicant clarify whether the level instruments were subject to an AMR, or justify their exclusion.

In its response, dated June 12, 2003, the applicant stated that the P&ID drawings provided for the LRA are the tools for license renewal scoping. The level instruments are not mechanical components and are not within the pressure boundary of the CWS. Therefore, P&ID drawings for the CWS are not required to be provided in the LRA. In addition, these instruments are active components that have no passive function and, therefore, are not subject to an AMR in accordance with 10 CFR 54.21(a)(1).

The staff's review finds the applicant's rationale acceptable for the level instruments not subject to an AMR. The staff agrees with the applicant that the level instruments are not mechanical components within the pressure boundary of the CWS. They are active components and have no passive intended function, and therefore, are exempted from AMR in accordance with 10 CFR 54.21(a)(1). As a result of this review, the staff did not identify any omissions.

2.3.3.5.3 Conclusions

The staff reviewed the LRA to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. No omissions were found. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. No omissions were found. On the basis of this review, the staff concludes that the applicant has adequately identified the CWS components that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has determined that no CWS components are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.6 Component Cooling Water System

2.3.3.6.1 Summary of Technical Information in the Application

The applicant describes the component cooling water (CCW) system in LRA Section 2.3.3.6 and provides a list of components subject to an AMR in LRA Table 2.3-22. The system is further described in UFSAR Section 9.2.2, Component Cooling Water System.

The CCW system serves as an intermediate, closed-loop cooling system to transfer heat from systems and components important to safety, including those that may contain radioactive (or potentially radioactive) fluids, to the service water system. The CCW system consists of two separate and independent loops that are each provided with emergency makeup water from the associated service water system train to makeup for leakage. The important to safety components supplied with cooling water by the CCW system include the residual heat removal pumps, the residual heat removal heat exchangers, and the centrifugal charging pumps. Thus, upon loss of one CCW cooling loop, cooling water remains available to the redundant component in each of these safety-related systems. The CCW system is also utilized during normal plant operation to transfer heat from various systems and components that are not important to safety, but could result in the release of radioactivity to the ultimate heat sink if direct, open loop cooling were used. This latter type of service is referred to as nonessential.

2.3.3.6.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.6 and UFSAR Section 9.2.2 to determine whether the CCW system components within the scope of license renewal and subject to an AMR had been identified in accordance with the requirements of 10 CFR 54.4 and 54.21(a)(1), respectively. The staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

In the performance of this review, the staff selected system functions described in the UFSAR that were set forth in 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of the Rule. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted.

During the review of LRA Table 2.3-22, which lists component types subject to an AMR, the staff noted that the table did not specifically describe flow venturis and radiation monitor housings as component types subject to an AMR. However, license renewal drawing D-302-612 indicated venturis at locations D4, D5, D6, and D7 were within scope, and drawing D-806-005 indicated that the CCW system radiation monitor housing was within scope. Accordingly, by letter dated March 28, 2003, in RAI 2.3.3.6-1, the staff requested that the applicant clarify whether these component types are included in a component type already listed in the table, or justify the exclusion of these component types from being subject to an AMR.

By letter dated June 12, 2003, the applicant responded to this RAI. The applicant stated that the venturis are listed as orifices and are included in LRA Table 2.3-22. The applicant also stated that the pressure boundary intended function of the radiation monitor housing is addressed in LRA Section 2.3.3.17. Therefore, these components are identified in the LRA as component types subject to an AMR.

By letter dated March 28, 2003, in RAI 2.3.3.6-2, the staff also requested that the applicant clarify the configuration of temperature monitoring devices in the system and identify the portions of these assemblies that are subject to an AMR. By letter dated June 12, 2003, the applicant responded to this request for additional information and stated that thermowells are used in temperature monitoring and are included in the scope of license renewal. Thermowells are listed in LRA Table 2.3-22 as a component type subject to an AMR.

2.3.3.6.3 Conclusions

The staff reviewed the LRA and the accompanying boundary drawings to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. No omissions were found. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. No omissions were found. On the basis of this review, the staff concludes that the applicant has adequately identified the components of the CCW system that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has adequately identified the components of the CCW system that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.7 Diesel Generator Services Systems

2.3.3.7.1 Summary of Technical Information in the Application

The applicant describes the emergency diesel generators (EDGs) and their support systems in LRA Section 2.3.3.7 and provides a list of components subject to an AMR in LRA Table 2.3-23. UFSAR Sections 9.5.4 and 9.5.8 provide additional information for the diesel generator services systems.

The EDG system consists of two EDGs and their support systems. The Rule recognizes that the EDGs are active components and are excluded from the group of equipment that are subject to an AMR, as required by 10 CFR 54.21(a)(1). The following are the support systems for each EDG:

- fuel oil storage and transfer system
- cooling water system
- starting air system
- lubrication system
- combustion air intake and exhaust system

The license renewal boundaries for the EDGs and their support systems are highlighted on the following P&ID drawings:

- D-302-222, Service Water System
- D-302-351, Diesel Generator Fuel Oil
- D-302-353, Diesel Generator Miscellaneous Service
- 1MS-32-005, Sheet 2, Fuel Oil System
- 1MS-32-005, Sheet 3, Lube Oil System
- 1MS-32-005 Sheet 4, Jacket Water System
- 1MS-32-005 Sheet 5, Intercooler & Injector Cooling System
- 1MS-32-005 Sheet 6, Starting & Control Air System
- 1MS-32-005 Sheet 7, Crank Case Vac Air Intake and Exhaust System

These supporting systems are further described in the following UFSAR Sections and are summarized as below:

- 9.5.4 Diesel Generator Fuel Oil Storage and Transfer System
- 9.5.5 Diesel Generator Cooling Water System
- 9.5.6 Diesel Generator Starting Air System
- 9.5.7 Diesel Generator Lubrication System
- 9.5.8 Diesel Generator Combustion Air Intake and Exhaust System

<u>Fuel Oil Storage and Transfer System</u>

Each EDG fuel oil storage and transfer system consists of a day tank, a fuel oil storage tank, two fuel oil transfer pumps, and its associated piping, valves, and I&Cs. Each day tank is automatically filled by its own EDG fuel oil storage tank with its own EDG fuel oil transfer pumps. A cross-tie with two normally closed valves is provided between the two EDGs at the fuel oil transfer pump suctions that allows the fuel oil transfer pumps of either EDG to fill either or both day tanks from either fuel oil storage tank.

Cooling Water System

The cooling water system consists of two subsystems — intercooler subsystem and jacket water subsystem, as described below.

Intercooler Subsystem:

The intercooler subsystem supplies cooling water to the turbocharger air intercoolers, alternator outboard bearing, and fuel injection nozzles. Circulation of cooling water is accomplished by an engine-driven centrifugal pump. Heat from the cooling water is rejected to the service water system through a thermostatically controlled heat exchanger. An expansion tank mounted on top of a standpipe is provided to serve both the intercooler subsystem and the jacket water subsystem.

Jacket Water Subsystem:

The jacket water subsystem is a closed system that cools the diesel engine. Cooling water is circulated through the cylinder liners, cylinder heads, and turbocharger cooling spaces by an engine-driven pump. Heat from the cooling water is rejected to the service water system through a thermostatically controlled heat exchanger. An electric heater and an auxiliary motor-driven pump are provided to allow "keep warm" operation under standby conditions.

Air Starting System

Each EDG is provided with two independent air starting systems, one for each bank of engine cylinders. Each bank of engine cylinders has its own engine-driven air start distributor with a connection to each cylinder. Using either or both banks can start the engine. Compressed air is supplied by two air storage tanks which are charged by two separate a-c motor driven air compressors. Because each of the air storage tanks is designed to store sufficient compressed air that permits five successive EDG starts without recharge (e.g., using both air storage tanks, 10 successive EDGs can start without recharge), those portions of the system used for charging the air storage tanks have no safety function and are non-critical quality element (CQE). Therefore, the air compressors and associated equipment are not highlighted in the P&ID drawings as being within the scope of license renewal.

Lubrication System

The lubrication system consists of three subsystems — engine lube oil subsystem, rocker lube subsystem, and auxiliary oil subsystem. The lube oil subsystem contains an engine-driven pump which draws oil through a suction strainer from the engine sump and delivers it to a thermostatically controlled lube oil cooler and then through a strainer to the main engine lube oil header. The header supplies oil to all main bearings under pressure and, through a pressure reducing valve, to the camshaft bearings, cam followers, fuel injection pumps, and valve push rods. This subsystem also provides oil to the crank pin journals for piston cooling, as well as to accessory gearing. A separate rocker lube subsystem supplies oil to each cylinder head rocker assembly. An auxiliary oil subsystem permits continuous prelubrication of the engines at "keep warm" temperature during standby.

Combustion Air intake and Exhaust System

The combustion air intake system consists of two filter/silencer units, mounted in a cubicle above the associated EDG, with connecting piping to the intake manifold of the engine. Each of the filter/silencer units serves one engine cylinder bank. The exhaust system consists of one muffler, mounted in a cubicle above the associated EDG, with connecting piping from the engine exhaust manifolds. A short exhaust stack extends from the muffler through the roof to the atmosphere.

2.3.3.7.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.7 and the cited UFSAR sections to determine whether the components of EDGs and their support systems within the scope of license renewal and subject to an AMR had been identified in accordance with the requirements of 10 CFR 54.4 and 10 CFR 54.21(a)(1), respectively. The staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

In the performance of this review, the staff selected system functions described in the UFSAR that were set forth in 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of license renewal. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted.

During its review, the staff determined that additional information regarding some components in the EDGs and their support systems was needed to complete its review. The components of diesel engine crankcase vacuum system (e.g., crankcase pump cases, oil separators, flex connectors, valves, piping, etc.) are neither identified in the P&ID drawings as being within the scope of license renewal nor included in LRA Table 2.3-23 for being subject to an AMR. The staff believed that these components are long-lived with a passive function, and therefore, should be subject to an AMR. In a letter dated March 28, 2003, in RAI 2.3.3.7-1, the staff requested the applicant to clarify whether these system components were subject to an AMR, or justify their exclusion.

In its response dated June 12, 2003, the applicant stated that these components do not have a license renewal intended function. Crankcase vacuum is not required for the diesel to operate. Crankcase vacuum is required for pollution control which is not a license renewal requirement. The failure of the crankcase vacuum system components would not prohibit the diesel from operating and meeting its license renewal intended function of supplying electric power. The staff finds the applicant's rationale acceptable for justifying the components of diesel engine crankcase vacuum system not subject to an AMR.

With regard to the fuel oil storage and transfer system, the system components (i.e., the vent line with flame arrestor for each fuel oil storage tank and each day tank, the manway for each fuel oil storage tank, and the fuel oil fill lines) are neither identified in the P&ID drawings as being within the scope of license renewal nor included in LRA Table 2.3-23 for being subject to an AMR. The staff believed that these components are long-lived with a passive function and, therefore, should be subject to an AMR. In a letter dated March 28, 2003, in RAI 2.3.3.7-2, the staff requested the applicant to clarify whether these system components were subject to an AMR, or justify their exclusion.

In its response dated June 12, 2003, the applicant stated that these components do not have a license renewal intended function. They are not required to contain the diesel fuel oil in the system. Their failure would not prevent the required amount of diesel fuel oil from being supplied to their associated EDG. The staff finds the applicant's rationale acceptable for justifying the cited diesel fuel oil system components not in scope nor being subject to an AMR for license renewal.

The components (i.e., expansion tanks, sight glasses, flex connectors, valves, piping, etc.) of the jacket water system were neither identified in the P&ID drawings as being within the scope of license renewal nor included in LRA Table 2.3-23 for an AMR. The staff believed that these components are long-lived with a passive function and, therefore, subject to an AMR. In a letter dated March 28, 2003, in RAI 2.3.3.7-3, the staff requested the applicant to clarify whether these system components were subject to an AMR, or justify their exclusion.

In its response dated June 12, 2003, the applicant stated that these components do not have a license renewal intended function. The 12-inch standpipe, which is within the scope of license renewal and subject to an AMR, has sufficient capacity to meet the volume requirements for containing the jacket cooling water. The expansion tank and components are provided for extra surge capacity and static head to ensure proper filling after maintenance. The tank is restrained such that it cannot fall and impact the EDG or any of its required auxiliaries. Their failure would not prevent the EDG from being supplied with the required amount of coolant to meet its license renewal intended function. The staff finds the applicant's rationale acceptable for justifying the jacket cooling system components not in scope nor being subject to an AMR for license renewal. As a result of this review, the staff did not identify any omissions.

2.3.3.7.3 Conclusions

The staff reviewed the LRA, UFSAR, and the applicant's response to the staff's RAIs to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. No omissions were found. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. No omissions were found. On the basis of this review, the staff concludes that the applicant has appropriately identified the components of the EDGs and their support systems that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has appropriately identified the components of the EDGs and their support systems that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.8 Fire Service System

2.3.3.8.1 Summary of Technical Information in the Application

The applicant describes the fire protection (FP) system in LRA Section 2.3.3.8, Fire Service System, and provides a list of components subject to an AMR in LRA Table 2.3-23. UFSAR Section 9.5.1, Fire Protection System, and Fire Protection Evaluation Report (FPER) provide additional information concerning the interior and exterior FP system.

The fire service system is designed to ensure adequate FP for each fire hazard. The total FP system provides fire detection, audible and visual alarms, and extinguishment. The safety functions of the fire service system include (1) fire protection water supply and distribution, (2)

fire detection and alarm, (3) fire extinguishing, (4) cooling of equipment and building exposed to fire, (5) control of fire spread, (6) inerting of hazardous atmospheres, and (7) efficient and effective use of proper fire extinguishing agent.

In accordance with 10 CFR 54.4(a)(3), the SSCs that are relied on in safety analyses or plant evaluations to demonstrate compliance with10 CFR 50.48, "Fire protection," are included within the scope of license renewal. The FP system at the plant is relied upon to meet the requirements of 10 CFR 50.48. LRA Section 2.1.1.4.1, Fire Protection, identified that SSCs relied upon in safety analyses or plant evaluations to perform a function that demonstrated compliance with the FP rule in 10 CFR 50.48 are within the scope of license renewal. In LRA Section 2.3.3.8, the applicant identified the FP flow diagrams (the P&ID drawings) that depict the license renewal boundaries for the FP system. The applicant also identified the components of the FP system that are evaluated in NUREG-1801 (AMPs), and that are not evaluated in NUREG-1801 in LRA Tables 3.3-1 and 3.3-2, respectively.

In accordance with 10 CFR 50.48, the applicant is required to implement and maintain a fire protection program (FPP). As stated in LRA Section 2.1.1.4.1, the plant's FPP is based on an evaluation of potential fire hazards throughout areas containing safe shutdown equipment, as well as potential fire hazards in various non-safe shutdown facilities and areas. The evaluation of potential fire hazard assures that the capability exists to safely shutdown the unit following loss of functions in any given fire area due to a fire, in compliance with Appendix A to 10 CFR Part 50, General Design Criterion (GDC) 3, "Fire Protection," and Branch Technical Position (BTP) Auxiliary and Power Conversion Systems Branch (APCSB) 9.5-1, Appendix A, February 24, 1977.

NUREG-0717, "Safety Evaluation Report Related to the Operation of Virgil C. Summer Nuclear Station, Unit 1," issued February 1981, and its supplements, provide the staff's evaluation which documents the plant's compliance with Appendix A to BTP APCSP 9.5-1 and in the CLB document. In addition, the plant's FPER contains the essential elements of the FPP. These elements are the fire hazard analysis (FHA), safe plant shutdown description, and a point-by-point comparison of the FPP with the guidance in Appendix A to BTP APCSP 9.5-1.

In LRA Section 2.1.1.4.1, the applicant states that the FP program is not considered as safety-related, the quality assurance (QA) program for FP is part of the overall QA program, and installation, testing, and subsequent operations of areas containing safety-related equipment are processed by procedures similar to those for safety-related work. In addition, in LRA Section 2.1.1.2.1, Safety-Related Mechanical Systems, the applicant uses a quality-related (QR) designation code flag that applies to components, systems, and associated activities that are non-safety-related, but warrant application of a quality plan or program to satisfy regulatory requirements or management decisions. The plant's QR designation applies to FP SSCs, and services containing the equipment that demonstrate compliance are considered to be in the license renewal scope.

In LRA Section 2.1.1.4.1, the applicant states that in order to ensure compliance with 10 CFR Part 50, Appendix R (Sections III.G, III.J, and III.O), the plant has performed additional analyses to provide further documentation of the ability of the unit to achieve safe shutdown in the event of a fire. These analyses are documented in the FPER. To safely shut down the plant without control from the control room, an alternate shutdown system is provided consisting of two independent shutdown panels and utilizing some local operator action. On the basis of

the methodology described above, the applicant identified that the highlighted components, shown on the FP flow diagrams and listed in LRA Section 2.3.3.8, are included within the scope of license renewal.

In LRA Table 2.3-24, the applicant identified that the FP system is within the scope of license renewal. In LRA Tables 3.3-1 and 3.3-2, the applicant identified the components and commodities groups (combinations of materials and environments) and the AMP evaluated in NUREG-1801 that are relied on for license renewal of the auxiliary systems.

2.3.3.8.2 Staff Evaluation

The NRC regulations in 10 CFR 54.21(a)(1), state that for those SSCs that are within the scope of this part, as delineated in 10 CFR 54.4, the applicant must identify and list those SSCs that are subject to an AMR. The staff reviewed LRA Section 2.3.3.8 to determine whether the applicant has appropriately identified that the SSCs that serve FP intended functions are within the scope of license renewal and subject to an AMR, in accordance with the requirements of 10 CFR 54.4 and 10 CFR 54.21(a)(1), respectively. The staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

The staff sampled portions of the UFSAR to identify any additional FP system function that meet the scoping requirements of 10 CFR 54.4, but that were not identified as an intended function in the LRA. The staff also reviewed NUREG-0717 and its supplements. This NUREG is referenced directly in the plant's CLB documents, and summarizes the FP program and commitments to 10 CFR 50.48 using the guidelines of Appendix A to BTP APCSB 9.5-1. The staff reviewed NUREG-0717 and its supplements to verify that the function of the FP components relied upon to satisfy the provisions of Appendix A to BTP APCSB 9.5-1 were included in the scope of license renewal as intended functions in the LRA.

The staff then compared the FP SSCs identified in the flow diagrams to verify that the required components were highlighted as being within the evaluation boundaries on the flow diagram, and were not excluded from the scope of license renewal. As part of the evaluation, the staff also sampled portions of the same flow diagrams for the FP system to determine if there were any additional portions of the system piping or components located outside of the evaluation boundary that should have been identified as being within the scope of license renewal.

After the staff's initial review of the LRA, the staff identified several concerns on the scoping and screening of FP SSCs required for compliance with 10 CFR 50.48. The staff identified a technical concern regarding the appropriateness of applying the QR designation applied during their scoping evaluation to identify all FP SSCs required for compliance with 10 CFR 50.48. The QR designation is the primary means relied upon by the applicant to identify FP SSCs. The applicant used QR flag on the LRA flow diagrams to identify FP SSCs that are in or out of scope. The in-scope FP SSCs are located within QR flags and are highlighted on the LRA flow diagrams, and the out-of-scope FP SSCs are outside of the QR flags that are isolated by manual valves. The staff does not agree with the applicant that the QR designation completely captured the FP SSCs required for compliance with 10 CFR 50.48. Therefore, the staff did not find that the QR designation included in scope are all of the FP SSCs required for compliance with 10 CFR 50.48. The scope of the SSCs required for compliance to GDC 3 and 10 CFR 50.48 goes beyond preserving the ability to maintain safe shutdown in the event of a fire. The staff noted that several FP systems and components listed in the SER (NUREG-0717),

including 20 gallons per minute (gpm) pressure maintenance pump (jockey pump), a sprinkler system installed in the diesel generator building, and fire hose stations in various buildings, which were excluded from the scope of license renewal, are required for compliance with 10 CFR 50.48. These concerns led to the issuance of RAIs, which were sent to the applicant in a letter dated March 28, 2003. The applicant responded to the RAI in letters dated June 12 and September 2, 2003, as discussed below.

In RAI 2.3.3.8-1(1), staff requested the applicant to provide the basis for excluding the FP piping leading to the alternate fire service (AFS) pump house, turbine building, a portion of the chilled water (CW) pump house, and the FP components (including jockey pumps, valves, piping, fittings, and diesel fuel tanks) from the scope of license renewal and subject to an AMR. In a letter dated June 12, 2003, the applicant responded that the AFS pumps are not credited for FP, because these pumps were installed for fire service needs during the construction of the station and are no longer used. However, the applicant expanded the scope to include the jockey pump (20 gpm pressure maintenance pump) and associated piping and components in the scope of license renewal. The applicant further stated that the components added by this expansion of scoping are subject to screening. If screened in, the FPP will manage the aging of these components. In a letter dated September 2, 2003, the applicant stated that it had performed further review and determined that these components are passive, long-lived, and support a license renewal intended function as a pressure boundary for fire service system. The FPP will manage the aging of these components for the period of extended operation.

The staff reviewed the applicant's response and agrees with the applicant to include the jockey pump and all the associated valves, piping, and fittings installed in the turbine building in the scope of license renewal as a part of the FP SSCs subject to an AMR. The staff further agrees that the AFS pump is not part of the fire suppression system. Therefore, the staff concurs with the applicant that the AFS pump should not be within the scope of license renewal to meet 10 CFR 50.48.

By letter dated March 28, 2003, in RAI 2.3.3.8-1(2), the staff requested the applicant to provide basis for excluding hydrants from the license renewal scope. These hydrants are in the system flow diagram D-302-231, Sht. 2, at locations H12, K8, K9, K10, K11, and K12.

In response to RAI 2.3.3.8-1(2), dated June 12, 2003, the applicant clarified that the fire hydrants in question are associated with fire hose houses 8, 9, 10, 17, 18, 19, and 20. All these fire hose houses are located outside of the protected area and are not in scope.

The staff finds the applicant's response to RAI 2.3.3.8-1(2) to be acceptable.

By letter dated March 28, 2003, in RAI 2.3.3.8-1(3), the staff requested the applicant to explain why the FP piping, fitting, valves, and fire hose stations at the reactor building (at locations E5, E7, and E8), fire hose connections in the fuel handling building (at location B4), fire hose connection in the auxiliary building (at location B13), fire hose connection in the intermediate building (at location H4), and fire hose connections in the reactor building (at location E9) are not highlighted in the system flow diagram (D-302-231, Sht. 3) as components within the scope of license renewal.

In a letter dated June 12, 2003, the applicant stated that the portion of piping in question in the reactor building (locations E5, E7, and E8 on LRA drawing D-302-231, Sht 3) is normally

isolated per 10 CFR Part 50, Appendix A, GDC 56. The highlighted portion of this piping is in scope for containment isolation only. The fire hose connections identified by the staff on drawing D-302-231, Sht. 3, in the fuel building (at location B4), auxiliary building (at location B13), and the intermediate building (at location H4) are included in the expanded scope for license renewal. The applicant further stated that the components added by this expansion of scope are subject to screening. In a letter dated September 2, 2003, the applicant stated that the plant had performed further review and determined that these components are passive, long-lived, and support a license renewal intended function as a pressure boundary for fire service system. The FPP will manage the aging of these components for the period of extended operation.

The staff reviewed the applicant's responses and agrees with the applicant that fire hose stations should be included in the expanded scope for license renewal. The staff also agrees with the applicant's justification for excluding piping in the reactor building (at locations E5, E7, and E8 on LRA drawing D-302-231, Sht 3) from scope of license renewal and from an AMR, since this piping does not serve any pressure boundary function for the FP system. Therefore, the staff finds the applicant's response to RAI 2.3.3.8-1(3) to be acceptable.

In RAI 2.3.3.8-1(4), the staff requested that the applicant provide the basis for excluding portions of the FP piping, fittings, valves, and fire connections from the scope of license renewal. These components are shown on the system flow diagram (D-302-231, Sht. 4) in the turbine building (at locations D6, E6, E7, E8, E9, E10, F7, F8, F9, and F10). The staff disagrees with the applicant's QR designation to isolate portions of the FP components by manual valves.

In a letter dated June 12, 2003, the applicant stated that the fire hose stations are included in the expanded scope for license renewal. The applicant further stated that the components added by this expansion of scope are subject to screening. If screened in, FPP will manage the aging of these components. In a letter dated September 2, 2003, the applicant stated that the plant had performed further review and determined that these components are passive, long-lived, and support a license renewal intended function as a pressure boundary for the fire service system. The FPP will manage the aging of these components for the period of extended operation.

The staff reviewed the applicant's response and agrees with the applicant's decision to include the FP piping, fittings, valves, and fire hose stations in the expanded scope for license renewal. Therefore, the staff finds the applicant's response to RAI 2.3.3.8-1(4) to be acceptable.

In RAI 2.3.3.8-1(5), the staff requested that the applicant provide a basis for excluding FP piping, fittings, and valves from the scope of license renewal and subject to an AMR. These components are shown in system flow diagram (D-302-231, Sht. 5), in south area, El 412' (at locations J6 to J9), of the turbine building.

In a letter dated June 12, 2003, the applicant stated that the valve manifolds are included in the expanded scope for license renewal. The applicant further stated that the components added by this expansion of scope are subject to screening. If screened in, FPP will manage the aging of these components. In a letter September 2, 2003, the applicant stated that the plant had performed further review and determined that these components are passive, long lived, and

support a license renewal intended function as a pressure boundary for fire service system. The FPP will manage the aging of these components for the period of extended operation.

The staff reviewed the applicant's response and agrees with the applicant that the valve manifolds should be included in the expanded scope for license renewal. Therefore, the staff finds the applicant's response to RAI 2.3.3.8-1(5) to be acceptable.

In RAI 2.3.3.8-1(6), the staff requested that the applicant provide basis for excluding the carbon dioxide (CO_2) system electric control panels and the IF&S system (in P&ID drawing D-302-232) from the scope of license renewal.

In response to RAI 2.3.3.15-5, dated June 12, 2003, the applicant clarified that the CO_2 system electric control panels and IF&S system are not within scope because these are active components.

The staff reviewed the applicant's response and finds the applicant's response to RAI 2.3.3.8-1(6) to be acceptable.

In RAI 2.3.3.8-1(7), the staff requested that the applicant provide basis for excluding the valve station system from the scope of license renewal. The system is shown in system flow diagram (1MS-55-059) in the turbine building. These FP components perform a pressure boundary intended function with the rest of the FP water supply system that is in scope.

In a letter dated June 12, 2003, the applicant stated that the valve manifolds will be included in the expanded scope for license renewal. The applicant further states that the components added by this expansion of scope are subject to screening. If screened in, the FPP will manage the aging of these components. In a letter September 2, 2003, the applicant stated that the plant had performed further review and determined that these components are passive, long-lived, and support a license renewal intended function as a pressure boundary for the fire service system. The FPP will manage the aging of these components for the period of extended operation.

The staff reviewed the applicant's response and agrees with the applicant's decision to include the valve manifolds in the expanded scope for license renewal. Therefore, the staff finds the applicant's response to RAI 2.3.3.8-1(7) to be acceptable.

By letter dated March 28, 2003, in RAIs 2.3.3.8-1(8) and (10), the staff requested the applicant to justify why the preaction sprinkler system should not be in scope. The system is installed in the diesel generator building and diesel fire pump room (as shown in system flow diagram 1MS-55-085, Sht. 26).

In its response dated June 12, 2003, the applicant stated that the fire suppression system for the diesel generator building and diesel fire pump on drawing 1MS-55-085, Sht. 26, should be highlighted as in scope. The system is listed as an FPER system by the plant procedures that control the requirements for the FPP. The components in this system are subject to an AMR and are encompassed by the component types listed in LRA Table 2.3.24.

The staff reviewed the applicant’s response and agrees with the applicant that the fire suppression system is within the scope of license renewal. The staff, therefore, finds the applicant’s response to RAIs 2.3.3.8-1(8) and (10) to be acceptable.

By letter dated March 28, 2003, in RAI 2.3.3.8-1(9), the staff requested the applicant to justify why the manual deluge sprinkler system for the charcoal filter plenum (XAA-40A-AH and XAA-40b-AH) is not in scope. The system is in the auxiliary building, as seem in system flow diagram 1MS-55-085-27-2.

In their response dated June 12, 2003, the applicant stated that the emergency safeguards feature filter system (i.e., control room emergency filter plenums and fuel handling charcoal exhaust fire suppression system) is within the scope of license renewal, but the manual deluge sprinkler system installed in charcoal filter plenums in the auxiliary building is not in scope.

The staff review NUREG-0717, and its supplements, and the CLB for fire suppression in all areas of the plant. The staff noted in NUREG-0717 (Supplement 3, August 1982) that no automatic fire suppression system is required in charcoal filter plenums located in rooms 85-01, 88-25, 97-02, 00-02, 12-11 North, and 36-18 of the auxiliary building. The staff, therefore, finds the applicant’s response to RAI 2.3.3.8-1(9) to be acceptable.

2.3.3.8.3 Conclusions

On the basis of its review described above, the staff concludes that the applicant has adequately identified the FP SSCs that are within the scope of license renewal and subject to an AMR in accordance with the requirements of 10 CFR 54.4(a) and 54.21(a)(1), respectively.

2.3.3.9 Fuel Handling System

2.3.3.9.1 Summary of Technical Information in the Application

The applicant describes the fuel handling system in LRA Section 2.3.3.9 and provides a list of components subject to an AMR in LRA Table 2.3-25. The system is further described in UFSAR Section 9.1.4, Fuel Handling System.

The fuel handling system consists of the equipment needed for transporting and handling fuel. The associated fuel handling structures may be generally divided into the (1) refueling cavity, (2) refueling canal and fuel transfer canal, which are flooded during plant shutdown for refueling, (3) spent fuel pool, which is kept full of water and is accessible to operating personnel, and (4) new fuel storage area. A fuel transfer tube connects the refueling canal and the fuel transfer canal. This tube is fitted with a blind flange on the refueling canal end and a gate valve on the fuel transfer canal end. This blind flange is always in place, except during refueling, to ensure containment integrity. The fuel transfer tube is required to maintain pressure boundary integrity.

2.3.3.9.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.9 and UFSAR Section 9.1.4 to determine whether the fuel handling system components within the scope of license renewal and subject to an AMR had been identified in accordance with 10 CFR 54.4 and 54.21(a)(1), respectively. The staff's

review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

In the performance of the review, the staff selected system functions described in the UFSAR that were set forth in 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of the Rule. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted.

During review of LRA Table 2.3-25, which lists component types subject to an AMR, the staff noted that the table lists only the fuel transfer tube as a component subject to an AMR. However, license renewal boundary drawing D-302-651 indicated that the following components are within scope — the fuel transfer tube, the fuel transfer tube blank flange, mechanical fasteners for blank flange, the valve body for the fuel transfer tube gate valve, and the piping and valve body for the vent line connected to the fuel transfer tube. Accordingly, by letter dated March 28, 2003, in RAI 2.3.3.9-1, the staff requested that the applicant clarify whether these components are included in a component type already listed in the table or justify the exclusion of these components from being subject to an AMR.

By letter dated June 12, 2003, the applicant responded to this RAI. The applicant stated that the mechanical component in the fuel handling system that is in scope is the transfer tube shown on drawing D-302-651. The fuel transfer tube [XNF0009-FH], including pipe, blind flange, and slip-on flange is installed inside a penetration sleeve. The fuel transfer tube is welded to the penetration sleeve, which connects the fuel transfer canal in the sheltered environment of the fuel handling building to the refueling cavity inside the reactor building. The applicant classified the penetration sleeve itself as a civil/structural commodity. Drawing D-302-651 also shows the spent fuel cooling system, which is described in LRA Section 2.3.3.22. The fuel handling system only included the tube proper and the flange located in the reactor building. The applicant stated that the associated gate valve body (XVM-06737-SF), the test valve (XVG-06657-SF), and the test valve pipe are included with the spent fuel cooling system in LRA Section 2.3.3.22. The applicant did not classify bolting as a separate component, but it is subject to inspections required by ASME Code. This response clarifies how the individual components that make up the fuel transfer tube assembly were included within the scope of license renewal and were subject to an AMR.

2.3.3.9.3 Conclusions

The staff reviewed the LRA and the accompanying scoping boundary drawings to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. No omissions were found. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. No omissions were found. On the basis of this review, the staff concludes that the applicant has adequately identified the components of the fuel handling system that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has adequately identified the components of the fuel handling system that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.10 Gaseous Waste Processing System

2.3.3.10.1 Summary of Technical Information in the Application

The applicant describes the gaseous waste processing system (GWPS) in LRA Section 2.3.3.10 and provides a list of components subject to an AMR in LRA Table 2.3-26. The system is further described in UFSAR Section 11.3, Gaseous Waste System.

The GWPS is designed to (1) remove fission product gases from the reactor coolant in the volume control tank and (2) collect gases from the boron recycle and waste evaporators, reactor coolant drain tank, recycle holdup tanks, and reactor vessel. The GWPS can hold fission gases indefinitely.

The license renewal intended functions of the GWPS are to maintain containment isolation for containment integrity and to maintain GWPS boundary with the component cooling water and chemical and volume control systems.

LRA Table 2.3-26 lists the following components subject to an AMR — channel head, shell, tubes, and tubesheet of heat exchangers; channel head, shell, spiral baffle, tube coils, and tube manifolds of helical heat exchangers; pipe; tube and tube fittings; and body of valves. This table also lists component intended functions.

2.3.3.10.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.10 and UFSAR Section 11.3 to determine whether the gaseous waste disposal system components within the scope of license renewal and subject to an AMR had been identified in accordance with 10 CFR 54.4 and 54.21(a)(1), respectively. The staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

In the performance of this review, the staff selected system functions described in the UFSAR that were set forth in 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of the Rule. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted.

During its review, the staff determined that additional information regarding some components in the GWPS was needed to complete its review. The system flow diagram drawing, E-302-745, rev. 3 (catalytic hydrogen recombiner B) shows the piping of cooler condenser continuing to drawing E-302-743. However, drawing E-302-743 is not included in the submittal nor referenced in LRA Section 2.3.3.10. In a letter dated March 28, 2003, in RAI 2.3.3.10-1, the staff requested the applicant to explain whether the license renewal boundary of gaseous waste processing system extends to drawing E-302-743 and requested the applicant to supply drawing E-302-743.

In its response, dated June 12, 2003, the applicant stated that drawing E-302-743 was not supplied with the application but is available in the UFSAR as Figure 11.3-4, sheet 2. If drawing E-302-743 were supplied as it highlighted, it would be the same as the recombiner shown on drawing E-302-742, which was supplied with the application. Drawing E-302-744 provides the detail of the A catalytic hydrogen recombiner. Drawing E-302-745 provides the detail of the B catalytic hydrogen recombiner. The staff finds that the applicant’s response contained sufficient information for the staff to complete its review.

The system flow diagram drawing, E-302-742, rev. 11 (waste processing) does not identify the heat-exchanger-shell-chemical-drain piping and valve 7938A to be within the scope of license renewal. This piping and the housing of the valve provide a pressure retaining function. The staff believed that these components are long-lived with passive function and, therefore, should be within the scope of license renewal and subject to an AMR. In a letter dated March 28, 2003, in RAI 2.3.3.10-2, the staff requested the applicant to justify their exclusion of these components from the scope of license renewal and subject to an AMR.

In its response, dated June 12, 2003, the applicant stated that the piping up to and including valves 7938A and 7938B are within scope. Drawings E-302-742, 743, 744, and 745 incorrectly show the safety class as "QRG" instead of "safety class 3." The staff finds the applicant's response acceptable because the component in scope is clarified.

2.3.3.10.3 Conclusions

The staff reviewed the LRA and the accompanying scoping boundary drawings to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. No omissions were found except a scoping boundary drawing was not supplied with its application. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. No omissions were found. On the basis of this review, the staff concludes that the applicant has adequately identified the components of the GWPS that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has adequately identified the components of the GWPS that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.11 Industrial Cooler System

2.3.3.11.1 Summary of Technical Information in the Application

The applicant describes the industrial cooler system in LRA Section 2.3.3.11. The applicant did not identify any components of this system subject to an AMR in LRA. The system is further described in UFSAR Section 9.4.7.2.5, Industrial Cooling System.

The industrial cooler system is a closed cooling system that supplies water to the cooling coils of the reactor building cooling units during normal operation. The service water system cools the reactor building cooling units during post-accident conditions following a loss of offsite power. The activation of an ESF actuation system signal automatically transfers the source of cooling water for the reactor building cooling units.

The only license renewal intended function of the industrial cooler system is to maintain reactor building temperature monitoring capability during accident conditions. The applicant stated that there are no mechanical components or component types required for the industrial cooler system to perform its system intended function, thus requiring no AMR.

2.3.3.11.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.11 and UFSAR Section 9.4.7.2.5 to determine whether the industrial cooler system components within the scope of license renewal and subject to an AMR had been identified in accordance with 10 CFR 54.4 and 54.21(a)(1). The staff's review

was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

In the performance of the review, the staff selected system functions described in the UFSAR that were set forth in 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of the Rule. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted. As a result of this review, the staff did not find any omissions.

2.3.3.11.3 Conclusions

The staff reviewed the LRA to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. No omissions were found. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. No omissions were found during the independent assessment. On the basis of this review, the staff concludes that the applicant has adequately identified the components of the industrial cooler system that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has adequately identified the components of the industrial cooler system that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.12 Instrument Air Supply System

2.3.3.12.1 Summary of Technical Information in the Application

The applicant describes the instrument air system in LRA Section 2.3.3.12 and provides a list of components subject to an AMR in LRA Table 2.3-27. The system is further described in UFSAR Section 9.3.1, Compressed Air System.

The instrument air system, including the reactor building air system, provides clean, dry air for instruments and controls. This system is not safety-related, with the exception of the containment isolation valves for the reactor building air system and the piping between them. The containment isolation valves for the reactor building air system and the piping between them are nuclear safety-related and in scope for license renewal because they form part of the containment isolation boundary. With the exception of a few components, instruments and controls served by the instrument air system fail in a safe position after a loss of air pressure. The following valves require air pressure to be placed in a safe position for certain design basis events—the feedwater isolation valves, the control room outside air dampers, the emergency feedwater system control valves, and the turbine driven emergency feedwater pump steam isolation valve. These air-operated devices are equipped with safety-related air volume tanks or accumulators, and these components are in scope for license renewal. Also in scope for license renewal are the air accumulators and associated air components for various valves required to perform a specified manipulation for event mitigation.

2.3.3.12.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.12 and UFSAR Section 9.3.1 to determine whether the instrument air system components within the scope of license renewal and subject to an AMR had been identified in accordance with 10 CFR 54.4 and 54.21(a)(1), respectively. The staff's

review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

In the performance of the review, the staff selected system functions described in the UFSAR that were set forth in 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of the Rule. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted.

Section 9.3.1.3 of the UFSAR identifies the feedwater isolation valves as valves that are required to function following an accident and that do not fail in a safe position after a loss of air supply. These air-operated valves are equipped with safety-related air accumulators to allow operation of the valves following a loss of air supply from the instrument air system. However, the applicant did not identify the accumulators and the related components necessary for operation of the feedwater isolation valves among the components identified in the drawings referenced in LRA Sections 2.3.3.12 and 2.3.4.5 as being within the scope of license renewal. Accordingly, by letter dated March 28, 2003, in RAI 2.3.3.12-1, the staff requested that the applicant clarify whether the accumulators and the related components necessary for the operation of the feedwater isolation valves are within the scope of license renewal and subject to an AMR, or justify their exclusion from being subject to an AMR in accordance with the requirements of 10 CFR 54.4(a) and 10 CFR 54.21(a)(1).

By letter dated June 12, 2003, the applicant responded to this RAI. The applicant stated that many components are typically supplied with various combinations of external-to-actuator air accumulator tanks, check valves, pressure regulators, and solenoid valves, which were evaluated with the instrument air system. These components are identified by the referenced drawings in LRA Section 2.3.3.12 and are included in the various line items of LRA Table 2.3-27. The accumulator is included as a tank. The applicant described that the accumulator for the feedwater isolation valve is integrated into the design of the valve actuator and is within the scope of license renewal, as indicated on license renewal drawing 1MS-25-898, "Actuator Cylinder Assembly."

The staff reviewed the response and found the response incomplete in that the associated piping and valves necessary to deliver air at adequate pressure from the accumulator to the actuator have not been adequately identified. By letter dated September 2, 2003, the applicant supplemented their response with additional details regarding boundaries for review within the complex assembly. The dried compressed air supplied to the valve from the Instrument Air System is split to supply two subcomponents. One subcomponent is the high-pressure air storage cylinder on the top of the operator. It is charged by a non-safety related air intensifier that increases the air pressure for the high-pressure air storage cylinder. The inlet to the high-pressure air storage cylinder has a check valve, which does not have a component identifier in the component database, that provides an isolation boundary. The inlet to the pilot air storage tank also has a check valve (XVG-01611A, B, or C-CV-FW), which provides an isolation boundary. The pressure retaining components downstream of these check valves provide an isolation boundary and are within the scope for license renewal. The staff found that this additional clarification acceptable.

The license renewal drawings referenced in LRA Section 2.3.3.12 identified the air accumulators for several valves and dampers that require air pressure to be positioned to their safe position or to actuate for event mitigation. However, the actuator housings associated with

these dampers and valves were not included in the scope of license renewal. By letter dated March 28, 2003, in RAI 2.3.3.12-2, the staff requested that the applicant clarify whether the portions of the associated actuator housings that perform a passive pressure boundary intended function are within the scope of license renewal and subject to an AMR, or justify their exclusion from being subject to an AMR in accordance with the requirements of 10 CFR 54.4(a) and 10 CFR 54.21(a)(1).

By letter dated June 12, 2003, the applicant responded to this RAI. The applicant stated that valve actuators are considered active components and are not subject to aging management review based on 10 CFR 54.21(a)(1)(i). The internal environment of air actuators is dried air, and the applicant stated that there are no aging effects that require management for these carbon steel actuators in dry air. Most of the actuators are in areas where leaking boric acid is not credible. Those in areas where leaking boric acid may be found would be subject to boric acid corrosion surveillances. These surveillances are performed to monitor the effect of leaking acid, not specific components. The external environment of the actuators is considered moist air. These actuators are located in a sheltered (i.e., indoors, non-condensing) environment. In this type of environment, pitting and crevice corrosion are not considered aging effects that require management. Therefore, the applicant concluded that the actuator will remain dry and, even if some general corrosion is experienced, it would not be severe enough to challenge the actuator’s ability to perform its intended function. The staff found this justification acceptable.

UFSAR Section 9.2.1.2 states that the fire protection system serves as a standby means of cooling the diesel generators. When the diesel generator is operating in the emergency mode, the cross-connect valve automatically opens on high lube oil temperature or high jacket water temperature. UFSAR Section 9.3.1.3 states that these fire protection system valves are equipped with QR air accumulators. By letter dated Mach 28, 2003, in RAI 2.3.3.12-3, the staff requested that the applicant clarify whether the accumulators and associated components are within the scope of license renewal and subject to an AMR. By letter dated June 12, 2003, the applicant responded to this RAI. The applicant stated that the accumulators and associated components for these valves (XVG-03105A/B-SW) are shown on license renewal drawing B-817-048 as in scope. Accumulators are listed as tanks in Table 2.3-27 of the LRA. The staff found that this response provided acceptable clarification of the LRA.

2.3.3.12.3 Conclusions

The staff reviewed the LRA and the accompanying scoping boundary drawings to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. No omissions were found. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. No omissions were found during the independent assessment. On the basis of this review, the staff concludes that the applicant has adequately identified the components of the instrument air system that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has adequately identified the components of the instrument air system that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.13 Leak Detection System

2.3.3.13.1 Summary of Technical Information in the Application

The applicant describes the leak detection system in LRA Section 2.3.3.13 but does not identify any components of this system subject to an AMR. The system is further described in UFSAR Section 7.6.5, Leakage Detection System.

The leak detection system detects leaks from the reactor coolant pressure boundary, ESF systems in the auxiliary building, and the feedwater system, and inputs to the plant annunciator system. The leak detection system isolates leaks in certain critical systems by pump tripping and valve closing through I&C.

The license renewal intended function of the leak detection system is to detect leaks of critical components by instruments comprising of level switches, level transmitters, temperature elements, and flow switches. The applicant stated that these instruments are all active, non-pressure boundary components, thus requiring no AMR.

2.3.3.13.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.13 and UFSAR Section 7.6.5 to determine whether the leak detection system components within the scope of license renewal and subject to an AMR had been identified in accordance with the requirements of 10 CFR 54.4 and 54.21(a)(1), respectively. The staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below. In the performance of this review, the staff selected system functions described in the UFSAR that were set forth in 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of the Rule. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted. As a result of this review, the staff did not identify any omissions.

2.3.3.13.3 Conclusions

The staff reviewed the LRA to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. No omissions were found. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. No omissions were found during the independent assessment. On the basis of this review, the staff concludes that the applicant has adequately identified the components of the leak detection system that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has adequately identified the components of the leak detection system that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.14 Liquid Waste Processing System

2.3.3.14.1 Summary of Technical Information in the Application

The applicant describes the liquid waste processing system (LWPS) in LRA Section 2.3.3.14 and provides a list of components subject to an AMR in LRA Table 2.3-28. The system is further described in UFSAR Section 11.2, Liquid Waste Systems.

The LWPS collects, segregates, and processes reactor-grade and non-reactor-grade liquid wastes produced during plant operation, refueling, and maintenance activities. The processed

reactor-grade stream is recycled for plant use. All the non-reactor-grade liquids are processed and disposed in accordance with applicable NRC regulations.

The LWPS does not perform any safety-related functions with respect to reactor cooling, shutdown, or accident mitigation. However, two of the lines in the system penetrate the containment and portions of the system are safety-related. The system also maintains a pressure boundary with safety-related systems, including the component cooling system and spent fuel cooling system.

LRA Table 2.3-28 lists the following components subject to an AMR — channel head, tubes, and tubesheet of condensers; shell, tubes, and tubesheet, manifold of heat exchangers; pipe; and body of valves. This table also lists component intended functions.

2.3.3.14.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.14 and UFSAR Section 11.2 to determine whether the liquid waste disposal system components within the scope of license renewal and subject to an AMR had been identified in accordance with 10 CFR 54.4 and 54.21(a)(1), respectively. The staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

In the performance of the review, the staff selected system functions described in the UFSAR that were set forth in 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of the Rule. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted.

During its review, the staff determined that additional information regarding some components in the LWPS was needed to complete its review. LRA Section 2.3.3.14 states that the licence renewal boundaries for the liquid waste processing system are depicted in drawing E-302-735. LRA Table 2.3-28 lists condensers and heat exchangers as components subject to an AMR. However, only one heat exchanger was identified in drawing E-302-735 (i.e., reactor coolant drain heat exchanger). In a letter dated March 28, 2003, in RAI 2.3.3.14-1, the staff requested the applicant to explain where the other heat exchanger/s and condensers could be found in the LRA.

In its response, dated June 12, 2003, the applicant stated that besides the components for the reactor coolant drain tank, the components for the waste evaporator are also included in LRA Section 2.3.3.14. The components for the waste evaporator can be found on drawing 1MS-09-238 which was provided as a license renewal boundary drawing. Drawing 1MS-09-238 should have been listed in LRA Section 2.3.3.14. The waste evaporator is shown on drawing E-302-736, which is UFSAR Figure 11.2-2, sheet 2. This drawing was not provided as a license renewal boundary drawing because it contains no components in scope. The staff finds the applicant’s response acceptable because the components in scope are clarified.

2.3.3.14.3 Conclusions

The staff reviewed the LRA and the accompanying scoping boundary drawing to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. No omissions were found. In addition, the staff performed an independent assessment to

determine whether any components subject to an AMR had not been identified by the applicant. No omissions were found during the independent assessment. On the basis of this review, the staff concludes that the applicant has adequately identified the components of the LWPS that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has adequately identified the components of the LWPS that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.15 Nuclear and Non-nuclear Plant Drains

2.3.3.15.1 Summary of Technical Information in the Application

The applicant describes the nuclear and non-nuclear plant drains system in LRA Section 2.3.3.15 and provides a list of components subject to an AMR in LRA Table 2.3-29. UFSAR Section 9.3.3 provides additional information for the system.

The nuclear and non-nuclear plant drains system provides drainage paths for potentially radioactive and non-radioactive liquid wastes through separate systems. Both systems drain and hold up the expected fire fighting water flow with floor drains and sumps, but without using sump pumps and associated discharge piping. The non-nuclear plant drains system does not require an AMR because it performs an active function to trip the circulating water pump in order to prevent flooding in the control and intermediate buildings. The nuclear plant drains system is subject to an AMR because it is passive and performs a license renewal intended function to provide reactor cavity drainage and containment isolation.

LRA Table 2.3-29 lists pipe and body of valves as the components subject to an AMR. This table also lists component intended functions.

2.3.3.15.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.15 and UFSAR Section 9.3.3 to determine whether the components of the nuclear and non-nuclear plant drains system within the scope of license renewal and subject to an AMR had been identified in accordance with the requirements of 10 CFR 54.4 and 54.21(a)(1), respectively. The staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

In the performance of this review, the staff selected system functions described in the UFSAR that were set forth in 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of the Rule. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted. As a result of this review, the staff did not identify any omissions.

2.3.3.15.3 Conclusions

The staff reviewed the LRA, the UFSAR, and the accompanying scoping boundary drawings to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. No omissions were found. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. No omissions were found during the independent assessment. On the basis of this review, the staff concludes that the applicant has adequately identified the components

of the nuclear and non-nuclear plant drains system that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has adequately identified the components of the nuclear and non-nuclear plant drains system that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.16 Nuclear Sampling System

2.3.3.16.1 Summary of Technical Information in the Application

The applicant describes the nuclear sampling system in LRA Section 2.3.3.16 and provides a list of components subject to an AMR in LRA Table 2.3-30. The system is further described in UFSAR Section 9.3.2, Process Sampling System.

The nuclear sampling system is designed for centralized sampling of primary system fluids and permits continuous steam generator blowdown flow to the secondary cycle sampling system for analysis. Samples requiring cooling and depressurization and which are, or could be, radioactive are piped to the nuclear sampling room. The nuclear sampling system includes sample vessels used at various locations throughout the plant. It also monitors primary letdown water for failed fuel detection.

The license renewal intended functions of the nuclear sampling system are (1) sampling reactor coolant and containment atmosphere following an accident, (2) maintaining containment isolation for containment integrity, and (3) maintaining system boundary with the component cooling system.

LRA Table 2.3-30 lists the following components subject to an AMR — shell and tubes of heat exchangers, pipe, casing of pumps, tanks, tube and tube fittings, and body of valves. This table also lists component intended functions.

2.3.3.16.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.16 and UFSAR Section 9.3.2 to determine whether the nuclear sampling system components within the scope of license renewal and subject to an AMR had been identified in accordance with the requirements of 10 CFR 54.4 and 54.21(a)(1), respectively. The staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

In the performance of the review, the staff selected system functions described in the UFSAR that were set forth in 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of the Rule. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted. As a result of this review, the staff did not identify any omissions.

2.3.3.16.3 Conclusions

The staff reviewed the LRA, the UFSAR, and the accompanying scoping boundary drawings to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. No omissions were found. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified

by the applicant. No omissions were found during the independent assessment. On the basis of this review, the staff concludes that the applicant has adequately identified the components of the nuclear sampling system that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has adequately identified the components of the nuclear sampling system that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.17 Radiation Monitoring System

2.3.3.17.1 Summary of Technical Information in the Application

The applicant describes the radiation monitoring system in LRA Section 2.3.3.17 and provides a list of components subject to an AMR in LRA Table 2.3-31. UFSAR Section 11.4 and Table 11.4-1 provide additional information for the system.

As indicated in the LRA, the license renewal review boundaries are depicted on the following P&ID drawings:

- D-302-611, Component Cooling
- D-302-651, Spent Fuel Cooling
- D-302-771, Nuclear Sampling
- D-806-010, Radiation Monitoring System Diagram Area Gamma
- D-806-011, Radiation Monitoring System Diagram Area Gamma

The radiation monitoring system is designed to monitor process and effluent streams from the plant in order to record and control releases of radioactive materials generated in the plant as a result of normal operations and during postulated accidents. The system continuously monitors plant effluent discharge paths under steady-state, transient, or accident conditions. After an accident, the system provides information to aid in determining the magnitude of the accident.

The following plant systems are monitored by the radiation monitoring system:

- component cooling water system
- primary coolant letdown system
- spent fuel cooling water system
- boron recycle system

The radiation monitoring system has an intended function to provide post-accident monitoring capability for the containment activities. The system control panel and alarm in the control room are part of the control instrumentation that are reviewed with the control room instrumentation. The system’s monitor assemblies, detectors, effluent flow measurement, and meteorological instrumentation are the active components of the system that are not within the scope of license renewal. In LRA Table 2.3-31, the applicant lists pipe, tanks, tube and tube fittings, and valves (body only) as the components of the radiation monitoring system subject to an AMR. These components are passive and perform their intended function without moving parts or without a change in configuration or properties, and they are not subject to replacement based on a qualified life or specified time period.

2.3.3.17.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.17, UFSAR Section 11.4, and the P&ID drawings to determine whether the components of the radiation monitoring system within the scope of license renewal and subject to an AMR had been identified in accordance with the requirements of 10 CFR 54.4(a) and 54.21(a)(1), respectively. The staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

In performing this review, the staff selected system functions described in the UFSAR that were set forth in 10 CFR 54.4(a) to verify that components having intended functions were not omitted from the scope of the Rule. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted.

During its review, the staff determined that additional information regarding some components in the system was needed to complete its review. LRA Section 2.3.3.17 indicates that one of the license renewal functions of the radiation monitoring system is to maintain system boundaries with the component cooling system, spent fuel cooling system, and chemical and volume control system (CVCS). The license renewal boundary drawings, D-302-611 (component cooling), D-302-651 (spent fuel cooling), and D-302-771 (nuclear sampling) highlight the piping and components within the scope of license renewal for these systems. However, the components of the radiation monitoring system in scope are not defined on these drawings. In a letter dated March 4, 2003, in RAI-2.3.3.17-1, the staff requested the applicant to highlight the license renewal boundaries for the radiation monitoring system in these P&ID drawings.

In its response dated April 3, 2003, the applicant stated that the only license renewal intended function for the liquid radiation monitors shown on these drawings is as pressure boundaries for the component cooling, spent fuel cooling, and nuclear sampling systems. Drawing D-806-005, which was not depicted in LRA Section 2.3.3.17, is the radiation monitoring system drawing that shows all the components of the monitors for the component cooling, spent fuel cooling, and nuclear sampling systems. The applicant stated that drawing D-806-005, rather than P&IDs D-302-611, D-302-651, and D-302-771, should have been the reference for liquid radiation monitors. In addition, the area monitors on P&IDs D-806-010 and D806-011 are not included in the LRA. Because these radiation monitors provide the required post-accident containment monitoring capability and are environmentally qualified. These monitors perform the safety function using an ion chamber probe inserted into the atmosphere of the reactor building. Therefore, its intended function is being performed by instrumentation, not by mechanical components. The instrumentation performs an active function and is excluded from the AMR, according to 10 CFR 54.21(a)(1).

The staff reviewed the applicant's response and additional drawings (i.e., D-806-005, D-806-010, and D-806-011) and found its rationale acceptable for defining the radiation monitoring system license renewal boundaries. The applicant has highlighted all the components of the radiation monitors on drawing D-806-005 that are within the scope of license renewal and listed pipe, tanks, tube and tube fittings, and valve in LRA Table 2.3-31 as the components subject to an AMR. As a result of this review, the staff did not identify any omissions.

2.3.3.17.3 Conclusions

The staff reviewed the LRA and the supplied P&ID drawings to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. No omissions were

found. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. No omissions were found during the independent assessment. On the basis of this review, the staff concludes that the applicant has adequately identified the components of the radiation monitoring system that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has adequately identified the components of the radiation monitoring system that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.18 Reactor Makeup Water Supply System

2.3.3.18.1 Summary of Technical Information in the Application

The applicant describes the reactor makeup water supply system in LRA Section 2.3.3.18 and provides a list of components subject to an AMR in LRA Table 2.3-32. UFSAR Section 9.2.7 and Table 9.2-17 provide additional information for the system.

The license renewal boundaries are depicted in the following P&ID drawings:

- D-302-651, Spent Fuel Cooling
- D-302-675, Chemical and Volume Control
- D-302-791, Reactor Makeup

The reactor makeup water supply system provides storage for the recycled primary coolant grade water. The system is designed to perform the following intended functions:

- supply water to the chemical and volume control system
- supply makeup water to the spent fuel pool
- provide a backup water supply for spray cooling in the pressurizer relief tank
- provide a water supply for makeup to and flushing of the reactor auxiliary systems
- provide storage capacity equal to or greater than the total of 84,000 gallon capacity of the recycle holdup tanks for the recycle primary coolant grade water produced in the boron recovery system and liquid waste processing system

The reactor makeup water pumps take suction from the reactor makeup water storage tank to perform various operations in makeup and flushing throughout the system. The portion of the reactor makeup water supply system between the reactor makeup water storage tank and the CVCS and spent fuel cooling system is safety-related, and the remainder of the system is non-safety-related.

2.3.3.18.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.18 and UFSAR Section 9.2.7 to determine whether the components of the reactor makeup water supply system within the scope of license renewal and subject to an AMR had been identified in accordance with 10 CFR 54.4(a) and 54.21(a)(1),

respectively. The staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

In performing this review, the staff selected system functions described in the UFSAR that were set forth in 10 CFR 54.4(a) to verify that components having intended functions were not omitted from the scope of the Rule. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted.

The staff reviewed LRA Table 3.2-32 and the P&ID drawings and did not find any omissions, except for a question regarding flow restrictors. Drawing D-302-791 highlights flow restrictors (i.e., xps-009-mu and xps-158-mu) as components of the reactor makeup water supply system within the license renewal scope. However, these components are not included in LRA Table 3.2-32. The flow restrictors are passive and long-lived and perform a pressure boundary intended function with the piping that is in scope. In RAI 2.3.3.18-2, the staff requested the applicant to clarify whether these flow restrictors should be in scope or justify their exclusion.

In its response, the applicant stated that these components are listed in Table 3.2-32 as the "orifices," that are subject to an AMR. As a result of this review, the staff did not identify any omissions.

2.3.3.18.3 Conclusions

The staff reviewed the LRA and the accompanying boundary drawings to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. No omissions were found. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. No omissions were found during the independent assessment. On the basis of this review, the staff concludes that the applicant has adequately identified the components of the reactor makeup water supply system that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has adequately identified the components of the reactor makeup water system that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.19 Roof Drains System

2.3.3.19.1 Summary of Technical Information in the Application

The applicant describes the roof drains system in LRA Section 2.3.3.19 and provides a list of components subject to an AMR in LRA Table 2.3-33. The roof drains system is not described in the UFSAR.

The roof drains system discharges water away from the demister banks and plenums of the reactor building cooling units (RBCUs). The RBCUs are capable of operation during emergency conditions with potential exposure to reactor building spray solution. The intended function of this system is to maintain the RBCU drain flow piping integrity. In LRA Table 2.3-33, the applicant lists "pipe" as component type subject to an AMR, as it serves as the pressure boundary for the roof drain system. The license renewal boundaries for the RBCU drains are depicted in P&ID drawing D-302-824.

2.3.3.19.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.19 and Table 2.3-33 to determine whether the roof drains system components within the scope of license renewal and subject to an AMR had been identified in accordance with 10 CFR 54.4(a) and 54.21(a)(1), respectively. The staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

The LRA states that the roof drains system provides drainage for various plant structures. The applicant determined that the drain piping from the demister banks and plenums of the RBCUs are within the scope of license renewal. These pipes are subject to an AMR because they are long-lived and perform a passive function. The piping for the drainage system does not provide any valves to control flow, because water in the plenums needs to be drained out continuously. The license renewal boundary drawing, D-302-824, highlights all the pipes from the plenums as the components within the scope of license renewal and subject to an AMR. As a result of this review, the staff did not identify any omissions.

2.3.3.19.3 Conclusions

The staff reviewed the LRA and drawing D-302-824 to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. No omissions were found. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. No omissions were found during the independent assessment. On the basis of this review, the staff concludes that the applicant has adequately identified the components of the roof drains system that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has adequately identified the components of the roof drain system that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.20 Station Service Air System

2.3.3.20.1 Technical Information in the Application

The applicant describes the station service air system (SSAS) in LRA Section 2.3.3.20, Station Service Air System, and provides a list of components subject to an AMR in LRA Table 2.3-34. The SSAS is further described in UFSAR Section 9.3.1, Compressed Air System.

The primary function of the SSAS is to provide compressed air for general plant use. The SSAS serves no safety function and is not required to achieve a safe reactor shutdown or to mitigate the consequences of a LOCA. Station service air is distributed via quick disconnect hose connections throughout the plant. The license renewal intended functions of the system are to provide means for containment integrity and to supply compressed air for the reactor building personnel, emergency personnel, and equipment hatches. The license renewal boundaries for the system are highlighted on P&ID drawings, D-302-241, "Station Service Air," and D-302-242, "Station Air Supply to Personnel, Emergency Personnel and Equipment Hatches."

2.3.3.20.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.20, the applicable portions of UFSAR Section 9.3.1, and the P&ID drawings to determine whether the SSAS components within the scope of license

renewal and subject to an AMR had been identified in accordance with the requirements of 10 CFR 54.4(a) and 10 CFR 54.21(a)(1), respectively. The staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

In the P&ID drawings, the applicant highlighted those portions, including valves, tubing, and piping, in the containment penetrations, that are required for providing containment isolation following a LOCA as being within the scope of license renewal. Also, the applicant identified the components with their intended functions in LRA Table 2.3-34.

During the review, the staff reviewed the components listed in LRA Table 2.3-34 and verified them with the P&ID drawings to ensure that components having intended functions were not omitted from the scope of license renewal. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted. The staff found that the components of the SSAS that have an intended function meeting the criteria of 10 CFR 54.4(a) have been identified as being within the scope of license renewal and subject to an AMR, in accordance with the requirements of 10 CFR 54.21(a)(1). As a result of this review, the staff did not identify any omissions.

2.3.3.20.3 Conclusions

The staff reviewed the LRA, UFSAR, and the P&ID drawings to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. No omissions were found. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. No omissions were found during the independent review. On the basis of its review, the staff concludes that the applicant has appropriately identified the SSAS components that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has appropriately identified the SSAS components that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.21 Service Water System

2.3.3.21.1 Summary of Technical Information in the Application

The applicant describes the service water system (SWS) in LRA Section 2.3.3.21 and provides a list of components subject to an AMR in LRA Table 2.3-35. The system is further described in UFSAR Section 9.2.1, Service Water System.

The SWS provides water from the service water pond for cooling of the emergency diesel generators, component cooling heat exchangers, HVAC mechanical water chiller condensers, and service water pumphouse cooling coils. During post-accident conditions, loss of offsite power or testing, the SWS cools the RBCUs. In addition, this system is the backup water source for the emergency feedwater and CCW systems. The system consists of two independent full capacity loops with the capability of valving a third swing service water pump into either loop. The SWS is safety-related and is designed such that a single failure does not cause loss of cooling to more than one of the redundant loops.

2.3.3.21.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.21 and UFSAR Section 9.2.1 to determine whether the SWS components within the scope of license renewal and subject to an AMR had been identified in accordance with 10 CFR 54.4 and 54.21(a)(1), respectively. The staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

In the performance of this review the staff selected system functions described in the UFSAR that were set forth in 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of the Rule. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted.

By letter dated March 28, 2003, in RAI 2.3.3.21-1, the staff requested that the applicant clarify the configuration of temperature monitoring devices in the system and identify the portions of these assemblies that are subject to an AMR. By letter dated June 12, 2003, the applicant responded to this RAI and stated that thermowells are used in temperature monitoring and are included in the scope of license renewal. Thermowells are listed in LRA Table 2.3-35 as a component type subject to an AMR.

The staff reviewed service water interfaces with other systems. License renewal boundary drawing (D-302-222) shows that the service water piping extends to drawing D-302-085 at locations D12 and H12 for backup supply to the emergency feedwater pump suction and to drawing D-302-611 at locations B8 and G8 for supply of CCW system makeup water. However, LRA Section 2.3.3.21 fails to reference drawings D-302-085 and D-302-611 to include service water piping on these flow diagrams within the AMPs identified for the SWS. Tables 2.3-22 and 2.3-40 of the LRA, which present aging management results for the CCW and emergency feedwater systems respectively, do not reference AMPs consistent with the component exposure to a raw water environment. A related issue exists with regard to FP system piping that extends onto SWS drawing D-302-222 at locations B8-9 and J8-9 for supply of backup cooling water to the EDGs from the FP water system. By letter dated March 28, 2003, in RAI 2.3.3.21-2, the staff requested that the applicant clarify how these piping segments have been included in an AMR and what AMPs apply to these piping segments.

By letter dated June 12, 2003, the applicant responded to this RAI. The applicant stated that the emergency feedwater alternate supply piping from the SWS up to check valves XVC-01034A/B-EF and XVC-01022A/B-EF is included in the scope of the SWS reliability and inservice testing program. The applicant also stated that the CCW system emergency makeup water supply piping from the SWS up to the check valves XVC-09680A/B-CC is included in the scope of the SWS reliability and inservice testing program. With respect to the alternate diesel generator cooling water supply from the FP water system, the applicant described that the SWS piping starts at the first breakdown orifices XPS-0146A and XPS-147A, and this piping is included in the scope of the SWS reliability and inservice testing program. The piping upstream of orifices XPS-0146A and XPS-147A is included in the scope of the FPP. The staff reviewed this information and found that the piping segments were included with appropriate systems based on the internal environment of the piping.

2.3.3.21.3 Conclusions

The staff reviewed the LRA and the accompanying scoping boundary drawings to determine whether any SSCs within the scope of license renewal had not been identified by the applicant.

No omissions were found. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. No omissions were found during the independent assessment. On the basis of this review, the staff concludes that the applicant has adequately identified the components of the SWS that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has adequately identified the components of the SWS that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.22 Spent Fuel Cooling System

2.3.3.22.1 Summary of Technical Information in the Application

The applicant describes the spent fuel pool cooling system in LRA Section 2.3.3.22 and provides a list of components subject to an AMR in LRA Table 2.3-36. The system is further described in UFSAR Section 9.1.3, Spent Fuel Cooling System.

The spent fuel cooling system cools spent fuel pool water to remove decay heat from the spent fuel elements. This system also (1) transfers water between the refueling water storage tank (RWST) and refueling cavity, (2) maintains purity and clarity of water in spent fuel pool and/or refueling cavity, (3) provides means for adding boric acid to the spent fuel pool, (4) provides means for adding demineralized water to the spent fuel pool, (5) monitors spent fuel coolant for excessive radioactivity due to defective fuel elements, (6) provides for filtering and/or demineralization to clean the water in the RWST, and (7) maintains a water shield above spent fuel elements to limit radiation levels in the area of the pool.

2.3.3.22.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.22 and UFSAR Sections 9.1.2 and 9.1.3 to determine whether the spent fuel cooling system components within the scope of license renewal and subject to an AMR had been identified in accordance with 10 CFR 54.4 and 54.21(a)(1). The staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

In the performance of this review the staff selected system functions described in the UFSAR that were set forth in 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of the Rule. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted. As a result of this review, the staff did not identify any omissions.

2.3.3.22.3 Conclusions

The staff reviewed the LRA and the accompanying scoping boundary drawings to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. No omissions were found. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. No omissions were found during the independent assessment. On the basis of this review, the staff concludes that the applicant has adequately identified the components of the spent fuel cooling system that are within the scope of license renewal, as required by 10 CFR 54.4(a), and

that the applicant has adequately identified the components of the spent fuel pool cooling system that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.23 Thermal Regeneration System

2.3.3.23.1 Summary of Technical Information in the Application

The applicant describes the thermal regeneration system (BTRS) in LRA Section 2.3.3.23 and provides a list of components subject to an AMR in LRA Table 2.3-37. The system is further described in UFSAR Section 9.3.4, Chemical and Volume Control System. The license renewal boundaries for the system are depicted in P&ID drawing E-302-676.

The LRA indicates that the load following capabilities of the (boron) thermal regeneration system were removed by plant modification MRF 21511. Now the BTRS continues to be used as the deborating demineralizers that reduce reactor coolant boron concentration towards the end of core life. The soluble neutron absorber (boric acid) concentration is controlled by the BTRS and the reactor makeup control system. The BTRS is also used to cool the letdown flow for enhanced reactor coolant pump (RCP) seal performance and to clean up the reactor coolant system (RCS) before shutting down the reactor. The letdown flow leaving the demineralizers may be directed to the BTRS. The coolant flows through the reactor coolant filter and then flows into the volume control tank through a spray nozzle on top of the tank. The BTRS is one of the subsystems of the CVCS that has an intended function to maintain a pressure boundary with the CVCS.

2.3.3.23.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.23, UFSAR Section 9.3.4, and the P&ID drawing to determine whether the components of the BTRS within the scope of license renewal and subject to an AMR had been identified in accordance with 10 CFR 54.4(a) and 54.21(a)(1), respectively. The staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

In performing this review, the staff selected system functions described in the UFSAR that were set forth in 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of the Rule. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted.

During its review, the staff determined that additional information regarding some components in the system was needed to complete its review. LRA Section 2.3.3.23 states that the BTRS is used as a deborating demineralizer to reduce reactor coolant boron concentration towards the end of core life. LRA Table 2.3-37 lists heat exchangers (channel head), heat exchangers (shell), heat exchangers (tubes), and heat exchangers (tube sheets) as the components of the BTRS subject to an AMR. LRA Table 2.3-8 lists heat exchangers as the components of the CVCS subject to an AMR. However, drawing E-302-676, which contains both the BTRS and the CVCS, shows that the heat exchangers are within the boundary of the CVCS. There are no heat exchangers in the boundary of the BTRS. In RAI 2.3.3.23-1, the staff requested the applicant to explain whether the heat exchangers in LRA Table 2.3-37 for the BTRS are those in LRA Table 2.3-8 for the CVCS and, if so, why the same heat exchangers are listed in both the tables.

In its response, the applicant stated that the letdown reheat, letdown chiller, and moderating heat exchangers are the components of the BTRS listed in LRA Table 2.3-37. The license renewal intended function for these components is to maintain a pressure boundary for the CVCS. The heat exchangers listed in LRA Table 2.3-8 are the CVCS heat exchangers for regenerative, excess letdown, seal water, and letdown. The license stated that drawings were highlighted during the screening process according to individual systems. Because there may be more than one system on a particular drawing, as in the case of E-302-676, the screening process resulted in multiple copies of a drawing showing highlighting for each system. These working copies are available on site for inspection. The drawings supplied to the NRC are composite drawings showing highlighting, in some instances, for multiple systems. Since the applicant has clarified that the heat exchangers listed in LRA Table 2.3-37 are the components of the BTRS being subject to an AMR, the staff finds the applicant's response acceptable.

The staff examined the SCs in LRA Table 2.3-37 to determine whether they are the only SCs that are subject to an AMR in accordance with 10 CFR 54.21(a)(1). On the basis of the above review, the staff did not find any omissions by the applicant.

2.3.3.23.3 Conclusions

The staff reviewed the LRA and the accompanying scoping boundary drawings to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. No omissions were found. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. No omissions were found during the independent assessment. On the basis of this review, the staff concludes that the applicant has adequately identified the components of the BTRS that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has adequately identified the components of the system that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.4 Steam and Power Conversion Systems

The steam and power conversion systems act as a heat sink to remove heat from the nuclear steam supply system and convert the heat generated in the reactor to the plant's electrical output.

2.3.4.1 Auxiliary Boiler Steam and Feedwater System

2.3.4.1.1 Summary of Technical Information in the Application

The applicant describes the auxiliary boiler steam and feedwater (AS) system in LRA Section 2.3.4.1 and provides a list of components subject to an AMR in LRA Table 2.3.38.

The AS system provides steam to various plant equipment, as required during all modes of operation. The system is non-safety-related and performs an intended function to isolate the section of the AS piping supplying the auxiliary building in order to prevent a high energy fluid piping rupture from affecting safety-related equipment in the auxiliary building. The license renewal boundaries of the system are depicted on the P&ID drawing, D-302-051, "Auxiliary Steam."

2.3.4.1.2 Staff Evaluation

The staff reviewed LRA Section 2.3.4.1 to determine whether the AS system components within the scope of license renewal and subject to an AMR had been identified in accordance with 10 CFR 54.4 and 54.21(a)(1). The staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

In the performance of the review, the staff selected system functions described in LRA Section 2.3.4.1 that were set forth in 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of the Rule. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted. As a result of this review, the staff did not identify any omissions.

2.3.4.1.3 Conclusions

The staff reviewed the LRA and the accompanying scoping boundary drawings to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. No omissions were found. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. No omissions were found during the independent assessment. On the basis of this review, the staff concludes that the applicant has appropriately identified the components of the AS system that are within the scope of license renewal, as required by 10 CFR 54.4, and that the applicant has appropriately identified the components of the AS system that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.4.2 Condensate System

2.3.4.2.1 Summary of Technical Information in the Application

The applicant describes the condensate system in LRA Section 2.3.4.2 and provides a list of components subject to an AMR in LRA Table 2.3.39. The system is further described in UFSAR Section 10.4.7. 1, Condensate System.

The condensate system pumps condensed turbine exhaust steam from the main condenser hotwell through the low pressure feedwater heaters to maintain deaerator storage tank level for anticipated operating conditions. It also serves as a source of cooling water for the steam packing condenser and steam blowdown heat exchanger, and provides sealing water for various vacuum valves and feedwater pump seals. Except for the condensate storage tank (CST), the condensate system is non-safety-related. The CST is safety-related because it is the primary inventory source for the emergency feedwater system. The license renewal boundaries for the system are depicted on the P&ID drawings, D-302-085 and 1MS-17-125.

2.3.4.2.2 Staff Evaluation

The staff reviewed LRA Section 2.3.4.2 and UFSAR Section 10.4.7.1 to determine whether the condensate system components within the scope of license renewal and subject to an AMR had been identified in accordance with 10 CFR 54.4 and 54.21(a)(1). The staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

In the performance of this review, the staff selected system functions described in the UFSAR that were set forth in 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of the Rule. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted.

During its review, the staff identified that the 10-inch atmospheric vent pipe on top of the CST was not highlighted in drawing D-302-101(at location A12) as being in scope and subject to an AMR for license renewal. Also, this vent pipe was not shown on the CST in drawing D-302-085. The staff believes that the vent pipe has an intended function to provide vacuum protection for the tank and is in scope. By letter dated March 28, 2003, in RAI 2.3.4.2-1, the staff requested the applicant to explain why this 10-inch vent pipe was not within the scope of license renewal. In its response dated June 12, 2003, the applicant stated that the 10-inch vent pipe performs its function by not being a pressure boundary and plugging of this vent pipe is not a credible event. In addition, the inspection of the tank by the mechanical components program will detect any degradation of the vent pipe.

The staff reviewed the applicant’s response and found it acceptable because the applicant has justified that the vent does not have a preserving pressure boundary function and is not in scope nor subject to an AMR for license renewal. The applicant further explained that this vent pipe was not shown on the CST in drawing D-302-085 because this drawing only shows emergency feedwater connections. The staff found the applicant’s response acceptable because it provides the reason for not showing the vent pipe on LRA drawing D-302-085.

During its review, the staff also identified that the piping attached to the CST, and up to the first isolation valve, was not highlighted in drawing D-302-101 as components within the scope of license renewal and subject to an AMR. By letter dated March 4, 2003, in RAI 2.3.4.2-2, the staff asked the licensee to justify the exclusion of the piping attached to the CST from the scope of license renewal. By letter dated April 3, 2003, the applicant stated that the CST is designed to have a reserve volume dedicated for use by the emergency feedwater (EF) system, that the connections below this reserve volume, and only those, are designated as EF components and are, therefore, within the scope of license renewal. The applicant further explained that other tank connections are located above this reserve volume, do not affect the water supply to the EF system and, therefore, are not included in scope for license renewal. The staff found the applicant’s response acceptable because it explains why some of the piping connected to the CST is not highlighted as components in the scope of license renewal. As a result of this review, the staff did not identify any ommissions.

2.3.4.2.3 Conclusions

The staff reviewed the LRA and the accompanying scoping boundary drawings to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. No omissions were found. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. No omissions were found during the independent assessment. On the basis of this review, the staff concludes that the applicant has adequately identified the components of the condensate system that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has adequately identified the components of the condensate system that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.4.3 Emergency Feedwater System

2.3.4.3.1 Summary of Technical Information in the Application

The applicant describes the emergency feedwater system in LRA Section 2.3.4.3 and provides a list of components subject to an AMR in LRA Table 2.3.40. The system is further described in UFSAR Section 10.4.9, Emergency Feedwater System.

The emergency feedwater system is designed to deliver feedwater to the steam generators for cooldown subsequent to a loss of feedwater supply and during an ATWS event. The system also supplies feedwater to the steam generators during testing, startup, shutdown, and layup operations. During normal plant operation, the system is in a standby condition, with the system controls set for automatic operation. The license renewal boundaries for the system are depicted on the P&ID drawings, D-302-085 and 1MS-17-125.

2.3.4.3.2 Staff Evaluation

The staff reviewed LRA Section 2.3.4.3 and UFSAR Section 10.4.9 to determine whether the emergency feedwater system components within the scope of license renewal and subject to an AMR had been identified in accordance with 10 CFR 54.4 and 54.21(a)(1), respectively. The staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

In the performance of this review, the staff selected system functions described in the UFSAR that were set forth in 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of the Rule. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted.

During its review, the staff identified that on drawing D 302-085, the license renewal boundaries of the emergency feedwater system piping terminate at locked open valves,1026-EF (at location G4), 1025A-EF (at location A5), and 1025B-EF (at location E5). It appeared that the 2-inch and 3-inch lines that extend upstream of these valves should be within the scope of license renewal to meet the requirements of 10 CFR 54.4(a)(2). By letter dated March 28, 2003, in RAI 2.3.4.3-1, the staff asked the applicant to explain why the 2-inch and 3-inch lines downstream of these valves and on the return path to the CST, up to and including check valve 1027-EF, are not highlighted as being within the scope of license renewal.

In its response dated June 12, 2003, the applicant stated that failure of the non-safety-related recirculation piping downstream of the breakdown orifices (located upstream of the locked open valves listed above) would not affect the ability of the emergency feedwater system to deliver 380 gpm to 2/3 steam generators and that this position was accepted as a part of the licensing basis. This is because failure to establish recirculation flow is mainly of concern when approaching hot shutdown (RHR conditions) while EF flow is being throttled back. The applicant further stated that the loss of condensate quality water due to postulated breakage of the non-safety-related recirculation piping would not compromise safe shutdown based on the provision of two trains of service water as backup. The staff found the applicant's response acceptable because the applicant demonstrated that failure of the non-safety-related recirculation lines downstream of the breakdown orifices (located upstream of the locked open

valves listed above) would not prevent satisfactory accomplishment of the function identified in 10 CFR 54.4(a)(ii). As a result of this review, the staff did not identify any omissions.

2.3.4.3.3 Conclusions

The staff reviewed the LRA and the accompanying scoping boundary drawings to determine whether any SSCS within the scope of license renewal had not been identified by the applicant. No omissions were found. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. No omissions were found during the independent assessment. On the basis of this review, the staff concludes the applicant has appropriately identified the components of the emergency feedwater system that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has appropriately identified the components of the emergency feedwater system that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.4.4 Extraction Steam System

2.3.4.4.1 Summary of Technical Information in the Application

The applicant describes the extraction steam system in LRA Section 2.3.4.4 and provides a list of components subject to an AMR in LRA Table 2.3-41. The system is not described in the UFSAR.

The extraction steam system supplies steam for heating the condensate and feedwater, and for maintaining the auxiliary boilers in a hot stand-by condition. The license renewal intended function of this system is to provide a means of main steam isolation for a steamline break coincident with failure of a main steam isolation valve.

LRA Table 2.3-41 lists pipe and body of valves as components subject to an AMR. This table also lists component intended functions. The license renewal boundaries of the system are depicted on P&ID drawing, D-302-041.

2.3.4.4.2 Staff Evaluation

The staff reviewed LRA Section 2.3.4.4 to determine whether the extraction steam system components within the scope of license renewal and subject to an AMR had been identified in accordance with 10 CFR 54.4 and 54.21(a)(1). The staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

In the performance of this review, the staff selected system functions described in LRA Section 2.3.4.4 that were set forth in 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of the Rule. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted. As a result of this review, the staff did not identify any omissions.

2.3.4.4.3 Conclusions

The staff reviewed the LRA and the accompanying scoping boundary drawing to determine whether any SSCs within the scope of license renewal had not been identified by the applicant.

No omissions were found. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. No omissions were found during the independent assessment. On the basis of this review, the staff concludes that the applicant has adequately identified the components of the extraction steam system that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has adequately identified the components of the extraction steam system that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.4.5 Feedwater System

2.3.4.5.1 Summary of Technical Information in the Application

The applicant describes the feedwater system in LRA Section 2.3.4.5 and provides a list of components subject to an AMR in LRA Table 2.3.4.2. The system is further described in UFSAR Section 10.4.7.2, Feedwater System.

The feedwater system pumps feedwater from the deaerator storage tank through two stages of high pressure heaters to the steam generators. The operation of the system ensures that the required amount of heated and deaerated water is available to maintain an adequate steam generator water level during normal plant operation and transients. The nuclear portion of the feedwater system conveys feedwater from the non-nuclear portion of the feedwater system (in the turbine building) to the steam generators, and includes the containment isolation valves.

2.3.4.5.2 Staff Evaluation

The staff reviewed LRA Section 2.3.4.5 and UFSAR Section 10.4.7.2 to determine whether the feedwater system components within the scope of license renewal and subject to an AMR had been identified in accordance with 10 CFR 54.4 and 54.21(a)(1), respectively. The staff's review was conducted in accordance with section 2.3 of the SRP-LR (NUREG-1800) and is described below.

In the performance of the review, the staff selected system functions described in the UFSAR that were set forth in 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of the Rule. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted. As a result of this review, the staff did not identify any omissions.

2.3.4.5.3 Conclusions

The staff reviewed the LRA and the accompanying scoping boundary drawings to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. No omissions were found. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. No omissions were found during the independent assessment. On the basis of this review, the staff concludes that the applicant has appropriately identified the components of the feedwater system that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has appropriately identified the components of the feedwater system that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.4.6 Gland Sealing Steam System

2.3.4.6.1 Summary of Technical Information in the Application

The applicant describes the gland sealing steam system (GSSS) in LRA Section 2.3.4.6 and provides a list of components subject to an AMR in LRA Table 2.3-43. The system is further described in UFSAR Sections 10.4.3 and 10.3.2.3.

The GSSS supplies steam to the main turbine and feedwater pump turbine shaft seals to prevent air leakage into and/or steam leakage out of the turbine casings. Sealing steam is normally supplied to the GSSS by the main steam system under all load conditions, but also can be supplied by the auxiliary boiler through the auxiliary steam system. The license renewal intended function of this system is to provide a means of main steam isolation for a steamline break coincident with failure of a main steam isolation valve.

LRA Table 2.3-43 lists pipe and body of valves as the components subject to an AMR. This table also lists component intended functions. The license renewal boundaries of the system are depicted on P&ID drawing D-302-141.

2.3.4.6.2 Staff Evaluation

The staff reviewed LRA Section 2.3.4.6 and UFSAR Sections 10.3.2.3 and 10.4.3 to determine whether the GSSS components within the scope of license renewal and subject to an AMR had been identified in accordance with 10 CFR 54.4 and 54.21(a)(1), respectively. The staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

In the performance of this review, the staff selected system functions described in the UFSAR that were set forth in 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of the Rule. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted.

During its review, the staff determined that additional information regarding some components in the GSSS was needed to complete its review. The license renewal boundary drawing of the GSSS (in drawing D-302-141, rev. 15) does not highlight the stop valve (S.V. # 1) as one of the components in the scope of license renewal. However, LRA Table 2.3-43 lists pipe and valve body as the component types subject to an AMR. Based on this review, the staff was unable to determine whether the stop valve was subject to an AMR. The valve body of the stop valve provides a pressure retaining function and the component is passive and long-lived. Therefore, the staff believed that this component should be in scope and subject to an AMR for license renewal. In a letter dated December 11, 2002, in RAI 2.3.4.6-1, the staff requested the applicant to clarify whether the valve body of the stop valve was in scope and subject to an AMR, or justify its exclusion.

In its response, dated January 27, 2003, the applicant stated that the four stop valves (S.V. #1–#4) are all in scope. They are shown on drawing D-302-012 and are included in LRA Section 2.3.4.7, Main Steam System. The staff finds the applicant's response acceptable because the applicant has clarified the components in scope. On the basis of the above review, the staff did not find any omissions by the applicant.

2.3.4.6.3 Conclusions

The staff reviewed the LRA and the accompanying scoping boundary drawing to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. No omissions were found. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. Again, no omissions were found during the independent assessment. On the basis of this review, the staff concludes that the applicant has adequately identified the components of the GSSS that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has adequately identified the components of the GSSS that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.4.7 Main Steam System

2.3.4.7.1 Summary of Technical Information in the Application

The applicant describes the main steam (MS) system in LRA Section 2.3.4.7 and provides a list of component types subject to an AMR along with their associated intended functions in LRA Table 2.3-44. UFSAR Section 10.3, Main Steam System, provides additional information for the MS system.

The MS system conveys saturated steam from the three steam generators to the turbine-generator. The system also supplies MS, through its branch lines, to the following systems and components:

- main feedwater pump drive turbines
- emergency feedwater pump drive turbine
- moisture separator reheaters
- auxiliary steam system
- deaerating feedwater heater
- steam dumps to the condenser and atmosphere

The license renewal boundaries of the MS system are highlighted on the following P&ID drawings:

- D-302-011, Main Steam (Nuclear)
- D-302-012, Main Steam (Non-Nuclear)
- D-302-014, Main & Reheat Steam (Non-Nuclear)
- D-302-121, Steam Drains
- D-302-122, Feed Pump Start-Up, Extraction & Mis. Steam Drains
- D-302-181, Turbine Cycle Sampling
- 1MS-17-125-5, Diagram-Terry Turbine Oil Piping

2.3.4.7.2 Staff Evaluation

The staff reviewed LRA Section 2.3.4.7 and UFSAR Section 10.3 to determine whether the MS system components within the scope of license renewal and subject to an AMR had been identified in accordance with 10 CFR 54.4 and 54.21(a)(1), respectively. The staff's review was

conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

In the performance of this review, the staff selected system functions described in the UFSAR that were required by 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of the Rule. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted. As a result of this review, the staff did not identify any omissions.

2.3.4.7.3 Conclusions

The staff reviewed the LRA and accompanying license renewal boundary drawings to determine whether any SSCs within the scope of license renewal had not been identified, as such, by the applicant. No omissions were found. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. Again, no omissions were found during the independent assessment. On the basis of this review, the staff concludes that the applicant has appropriately identified the components of the MS system that are within the scope of license renewal, as required by 10 CFR 54.4, and that the applicant has appropriately identified the components of the MS system that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.4.8 Main Steam Dump System

2.3.4.8.1 Summary of Technical Information in the Application

The applicant describes the main steam dump system in LRA Section 2.3.4.8 and provides a list of component types subject to an AMR along with their associated intended functions in LRA Table 2.3-45. The system is further described in UFSAR Section 10.4.4, “Turbine Bypass System.”

The MS system is capable of following a large turbine-generator load reduction without reactor trip through actuation of the main steam dump system. This system bypasses main steam to the main condenser and/or to the atmosphere. Steam dump valves permit unit operation at turbine loads lower than the minimum power setting (15 percent reactor power) of the nuclear steam supply system (NSSS) automatic control. In addition, the steam dump valves permit reduction of turbine-generator load at a rate greater than the 5 percent per minute maximum rate of load reduction for the NSSS.

The license renewal intended function of this system is to provide a means for main steamline isolation (when used in conjunction with components of various other systems) following a main steamline break coincident with the failure of a main steam isolation valve (MSIV). The license renewal boundaries are depicted on P&ID drawing, D-302-031, "Main Steam Dump System.”

2.3.4.8.2 Staff Evaluation

The staff reviewed LRA Section 2.3.4.8, and UFSAR Section 10.4.4 to determine whether the main steam dump system components within the scope of license renewal and subject to an AMR had been identified in accordance with 10 CFR 54.4 and 54.21(a)(1), respectively. The

staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

In the performance of this review, the staff selected system functions described in the UFSAR that were required by 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of the Rule. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted. As a result of this review, the staff did not identify any omissions.

2.3.4.8.3 Conclusions

The staff reviewed the LRA and the accompanying scoping boundary drawings to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. No omissions were found. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. Again, no omissions were found during the independent assessment. On the basis of this review, the staff concludes that the applicant has appropriately identified the components of the main steam dump system that are within the scope of license renewal, as required by 10 CFR 54.4, and that the applicant has appropriately identified the components of the main steam dump system that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.4.9 Main Turbine and Turbine Accessories Systems

2.3.4.9.1 Summary of Technical Information in the Application

The applicant describes the main turbine and turbine accessories systems in LRA Section 2.3.4.9. The system is further described in UFSAR Section 10.2, Turbine Generator.

The main turbine system receives main steam from the steam generators, via the MS system, and converts the steam energy into mechanical energy for the main generator. The turbine accessories system supplies high pressure bearing lift oil to the turbine and generator bearings to lift the shaft slightly and reduce the torque requirements on the turning gear. These two systems provide turbine trip signals that have a license renewal intended function of providing a means of main steam isolation (when used in conjunction with various other systems) following a main steamline break coincident with the failure of a MSIV. There are no mechanical components required for the main turbine or turbine accessories systems to perform their system intended functions; therefore, no AMR is required and no P&ID drawings are provided to depict these license renewal evaluation boundaries.

2.3.4.9.2 Staff Evaluation

The staff reviewed LRA Section 2.3.4.9 and UFSAR Section 10.2 to determine whether the components of the main turbine and turbine accessories system within the scope of license renewal had been identified in accordance with 10 CFR 54.4. The staff also reviewed those same components to determine whether any of them are subject to an AMR in accordance with 10 CFR 54.21(a)(1). The staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

In the performance of this review, the staff selected system functions described in the UFSAR that are required by 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of the Rule. The staff also focused on those same components to determine if any of them should be subject to an AMR. As a result of this review, the staff did not identify any omissions by the applicant.

2.3.4.9.3 Conclusions

The staff reviewed the LRA and the UFSAR to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. No omissions were found. In addition, the staff performed an independent assessment to determine whether any components of the main turbine and turbine accessories systems subject to an AMR had been identified by the applicant. No components subject to an AMR were found. On the basis of this review, the staff concludes that the applicant has appropriately identified the components of the main turbine and turbine accessories systems that are within the scope of license renewal, as required by 10 CFR 54.4, and that the applicant has rationally concluded that there are no components of the main turbine and turbine accessories systems that are subject to an AMR in accordance with 10 CFR 54.21(a)(1).

2.3.4.10 Turbine Cycle Sampling System

2.3.4.10.1 Summary of Technical Information in the Application

The applicant describes the turbine cycle sampling system in LRA Section 2.3.4.10 and provides a list of component types subject to an AMR along with their associated intended functions in LRA Table 2.3-46. The system is further described in UFSAR Section 10.3.5, Water Chemistry

The turbine cycle sampling system provides sampling of secondary system fluids from locations such as the main condenser hotwell, deaerator, feedwater booster pumps, high pressure heater drains, emergency feedwater pumps, and main steam system. The license renewal intended function of this system is to provide a means of main steam isolation (when used in conjunction with various other systems) for a steamline break coincident with MSIV failure. The system license renewal boundaries are highlighted on P&ID drawings D-302-012, “Main Steam System,” and D-302-181, “Turbine Cycle Sampling.”

2.3.4.10.2 Staff Evaluation

The staff reviewed LRA Section 2.3.4.10 and UFSAR Section 10.3.5 to determine whether the turbine cycle sampling system components within the scope of license renewal and subject to an AMR had been identified in accordance with 10 CFR 54.4 and 54.21(a)(1), respectively. The staff’s review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

In the performance of this review, the staff selected system functions described in the UFSAR that are required by 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of license renewal. The staff also focused on components that were not

identified as being subject to an AMR to determine if any components were omitted. As a result of this review, the staff did not identify any omissions.

2.3.4.10.3 Conclusions

The staff reviewed the LRA and the accompanying scoping boundary drawings to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. No omissions were found. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. Again, no omissions were found during the independent assessment. On the basis of this review, the staff concludes that the applicant has appropriately identified the components of the turbine cycle sampling system that are within the scope of license renewal, as required by 10 CFR 54.4, and that the applicant has appropriately identified the components of the turbine cycle sampling system that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.4.11 Steam Generator Blowdown System

2.3.4.11.1 Summary of Technical Information in the Application

The applicant describes the steam generator blowdown system in LRA Section 2.3.4.11 and provides a list of component types subject to an AMR along with their associated intended functions in LRA Table 2.3-47. The system is further described in UFSAR Section 11.4.8, Steam Generator Blowdown System.

The steam generator blowdown system continuously purges the steam generators of concentrated impurities, thereby maintaining secondary side steam generator water chemistry. This system is non-safety-related, except for the portion inside the reactor building, up to and including the containment isolation valves. The system license renewal boundaries are highlighted on P&ID drawings D-302-771, “Nuclear Sampling,” and D-302-781, “Steam Generator Blowdown.”

2.3.4.11.2 Staff Evaluation

The staff reviewed LRA Section 2.3.4.11 and UFSAR Section 11.4.8 to determine whether the steam generator blowdown system components within the scope of license renewal and subject to an AMR had been identified in accordance with 10 CFR 54.4 and 54.21(a)(1), respectively. The staff’s review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

In the performance of the review, the staff selected system functions described in the UFSAR that are required by 10 CFR 54.4 to verify that components having intended functions had not been ommitted from the scope of the Rule. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted. As a result of this review, the staff did not identify any omissions.

2.3.4.11.3 Conclusions

The staff reviewed the LRA and accompanying license renewal boundary drawings to determine whether any SSCs within the scope of license renewal had not identified been by the

applicant. No omissions were found. In addition, the staff performed an independent assessment to determine whether any components subject to an AMR had not been identified by the applicant. Again, no omissions were found during the independent assessment. On the basis of this review, the staff concludes that the applicant has appropriately identified the components of the steam generator blowdown system that are within the scope of license renewal, as required by 10 CFR 54.4, and that the applicant has appropriately identified the components of the steam generator blowdown system that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.4.12 Turbine Electro-Hydraulic System

2.3.4.12.1 Summary of Technical Information in the Application

The applicant describes the turbine electro-hydraulic system in LRA Section 2.3.4.12, but does not provide any table to list system components subject to an AMR. The system is further described in UFSAR Section 10.2.2.2, Turbine Generator Control.

The turbine electro-hydraulic system actuates and controls the turbine steam valves. This system is completely separated from the bearing oil supply. During normal plant operation, reactor power is controlled to match turbine load as measured by turbine first stage pressure. The turbine electro-hydraulic control system establishes the desired turbine steady-state load. Stage pressure feedback compares stage pressure (actual load) with desired load and uses the error signal to keep the actual load in agreement with the desired load. This system provides turbine trip signals that have license renewal functions of ATWS mitigation and main steam isolation (when used in conjunction with various other systems) for a main steamline break coincident with MSIV failure. There are no mechanical components required for the system to perform its system intended functions; therefore, no AMR is required and no P&ID drawings are provided to depict these license renewal boundaries.

2.3.4.12.2 Staff Evaluation

The staff reviewed LRA Section 2.3.4.12 and UFSAR Section 10.2.2.2 to determine whether the turbine electro-hydraulic control system components within the scope of license renewal had been identified, in accordance with 10 CFR 54.4. The staff also reviewed those same components to determine whether any of them are subject to an AMR, in accordance with 10 CFR 54.21(a)(1). The staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described below.

In the performance of this review, the staff selected system functions described in the UFSAR that are required by 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of the Rule. The staff also focused on those same components to determine if any of them should be subject to an AMR. As a result of this review, the staff did not identify any omissions.

2.3.4.12.3 Conclusions

The staff reviewed the LRA and the UFSAR to determine whether any SSCs within the scope of license renewal had not been identified by the applicant. No omissions were found. In addition, the staff performed an independent assessment to determine whether any components of the

turbine electro-hydraulic control system subject to an AMR had not been identified by the applicant. No components were found during the independent assessment. On the basis of this review, the staff concludes that the applicant has appropriately identified the components of the turbine electro-hydraulic control system that are within the scope of license renewal, as required by 10 CFR 54.4, and that the applicant has rationally concluded that there are no components of the turbine electro-hydraulic control system that should be subject to an AMR, in accordance with 10 CFR 54.21(a)(1).

2.3.5 Criterion 2 Supplement to the License Renewal Application

The SOC for the license renewal rule states that the object of a license renewal review is to determine whether the detrimental effects of aging, which could adversely affect the functionality of SSCs that the Commission determines require review for the period of extended operation, are adequately managed. Section 54.4(a)(2) of Title 10 of the *Code of Federal Regulations* requires all the non-safety-related SSCs whose failure could prevent satisfactory accomplishment of any of the safety-related functions identified in 10 CFR 54.4(a)(1) to be included in the scope of license renewal. The SOC also provides additional guidance on the Criterion 2 scoping review. Specifically, the applicant is required to determine non-safety-related SSCs (related to seismic II/I issues) in scope based on the plant's CLB, existing engineering evaluations, and actual plant-specific experience, as well as appropriate industry-wide operating experiences.

2.3.5.1 Summary of Technical Information in the Application

LRA Section 2.1.1.3 provides non-safety-related criteria pursuant to 10 CFR 54.4(a)(2). LRA Subsection 2.1.1.3.1 describes the scoping and screening methodologies for identifying SSCs that are within the scope of license renewal, in accordance with the requirements of 10 CFR 54.4(a)(2). The LRA also provides information on non-safety/safety interactions and methods for identifying the non-safety-related system components to meet 10 CFR 54.4(a)(2). The applicant documented its scoping and screening results in LRA Sections 2.3 and 2.4 and highlighted the in-scope piping and components in P&ID drawings. However, the non-safety-related piping systems having a spatial relationship with safety-related components and equipment are not evaluated in the LRA. The LRA states that Criterion 2 scoping results for these non-safety-related SSCs are provided in a supplementary submittal to the NRC.

On September 12, 2002, the applicant submitted a technical report (RC-02-0159), entitled "Section 2 Scoping and Screening Refined Criterion 2," to document its position on the integrated plant assessment of non-safety-related system components that are spatially oriented near safety-related components and equipment. The report provides the applicant's assessment results for non-safety-related system components to meet Criterion 2. These non-safety-related components may require an AMR to ensure that their limited structural integrity and/or pressure boundary are maintained. The applicant indicated that high energy piping, alternate isolation of steam-lines, instrument air, flooding, insulation, seismic, code break, and leaks are considered for Criterion 2 scoping of the non-safety-related components. As a result of this reassessment, certain non-safety-related systems and components not initially included in the license renewal scope were added to the expended scope for AMR due to spatial interactions. These systems and components are required to maintain their limited structural

integrity and/or pressure boundary to preclude adverse affects on nearby safety-related components and equipment. The following addresses the staff's review of the technical report.

2.3.5.2 Staff Evaluation

The staff reviewed the applicant's technical report. Specifically, the staff carefully reviewed the applicant's scoping methodology and results for identifying seismic II/I piping systems and components. The staff's review was conducted in accordance with Section 2.3 of the SRP-LR (NUREG-1800) and is described as below.

In the technical report, the applicant identified the following buildings containing both safety-related and non-safety-related components and equipment that may have spatial interactions:

- Auxiliary Building
- Control Building
- Diesel Generator Building
- Fuel Handling Building
- Intermediate Building
- Reactor Building
- Service Water Pump House

The applicant reevaluated all plant systems or portions of the systems in these buildings that have non-safety-related piping and components to identify their possible spatial relationship with safety-related components. The systems having non-safety-related piping and piping components in the designated buildings were first assumed to be in scope for spatial interaction consideration. The applicant then evaluated plant design documents and routing/configuration of system piping to determine whether certain non-safety-related portions can be removed from this consideration. For those non-safety-related portions of the system found to be in scope, the applicant further justified their inclusion. The technical report refers to the non-safety-related seismic II/I components as anti-falldown components and developed anti-falldown criteria (i.e., refined Criterion 2). The staff reviewed the applicant's anti-falldown criteria and found the criteria acceptable on the basis that they conform with NRC guidance regarding scoping seismic II/I piping systems.

Refined Criterion 2 has the concern not only that non-safety-related piping and components could fall during the extended operation but also they would be subject to the same plausible aging effects as the in-scope piping with the possible resulting degradation causing an adverse spatial interaction with safety-related equipment. With this concern, the applicant reevaluated pipe failures for (1) non-safety-related piping and components that are connected to safety-related piping systems (i.e., code breaks) and (2) non-safety-related piping that has a spatial relationship such that its failure could adversely impact a safety-related system intended function. The applicant evaluated the anti-falldown components against refined Criterion 2 in the following areas.

<u>Code Break Piping</u>

Code break piping is the piping in non-safety-related piping systems from code pipe to the outer-most code class break support. The applicant defined code-class break support as those pipe supports on non-safety-related piping that are designed to ensure that significant stresses

are not induced into safety-related piping at safety-class boundaries. Code break supports protect essential equipment by extending the design requirements for safety-related piping beyond the class change until one support (at a minimum) in each of the three mutually perpendicular transverse directions (or the equivalent) is provided. Code break piping is within the scope of license renewal to preclude adverse effects on safety-related equipment and functions. The applicant evaluated the non-safety-related piping that is connected to safety-related piping to determine whether the boundary of the safety-related portions in scope are also applicable to the adjoining code break piping. Specifically, seismic effects of non-safety-related piping are to be isolated from safety-related piping systems. As a result, the applicant identified the non-safety-related piping between the non-safety-related cycle industrial cooler (CI) system and the safety-related service water (SW) system in the expended scope for license renewal to meet Criterion 2.

Non-Mechanical Component

The applicant indicated that anti-falldown requirements for various SCs are for structural supports rather than assuming the function of the supported mechanical components. The structural supports have been evaluated in LRA Sections 2.4 and 3.5. The applicant determined that no further evaluation is required per refined Criterion 2.

Insulation

The applicant assessed the insulation types (such as MIRROR, mechanically bonded glass fiber blanket, calcium/silicate, and fiberglass) for possible age-related degradation of insulation materials and their impact. The applicant did not identify any potential falling insulation materials on safety-related components. Therefore, no insulation needs to be included in the scope to meet refined Criterion 2.

Ductwork

The applicant reevaluated the HVAC ductwork in the designated buildings to determine whether it is anti-falldown ductwork. The applicant found that those portions of the ductwork of concern are already included in the scope of license renewal. The existing IPA results are applicable to the anti-falldown ductwork. The applicant determined that no further evaluation is required per refined Criterion 2.

Pipe Failure/Rupture

Safety-related high energy piping and associated protection devices, such as restraints, barriers, and shields, were initially included in the license renewal scope and subject to an AMR. The applicant determined that no further evaluation is required per refined Criterion 2.

Analyzed High-Energy Lines

To maintain the seismic design and retain a safety margin, the applicant classified certain non-safety-related portions of several high energy lines as QR. The portions of the QR piping were initially included in the scope of license renewal. The applicant determined that no further evaluation is required per refined Criterion 2.

Unanalyzed High-Energy Lines

Portions of the piping in the steam generator blowdown (BD) system and several MS drains were not analyzed and were not initially included in the scope of license renewal. The applicant's reevaluation determined the non-safety-related BD system piping from the containment isolation valves to the turbine building/intermediate building wall to be included in the expended scope and subject to an AMR for license renewal per refined Criterion 2. The non-safety-related MS drains in the auxiliary building and intermediate building are also included in the scope of license renewal to meet refined Criterion 2.

Flow Limitation/Blockage

Certain non-safety-related portions of the mechanical systems were classified as QR to ensure that function of the system would not be inhibited by restricted flow during or after a seismic event. These QR portions were initially included in the scope of license renewal. The applicant determined that no further evaluation is required per refined Criterion 2.

Wetting (Moderate or High-Energy)

The effects of wetting on safety-related components, such as wetting from spray or leakage, are not explicitly addressed on building composite drawings. The areas identified on those drawings containing safety-related equipment are the areas where wetting due to failure of non-safety-related and/or QR fluid piping and components could adversely impact safety-related components. The applicant evaluated the non-safety-related and/or QR fluid systems for wetting considerations and found that these system portions were initially included in the scope of license renewal for other considerations.

Essential equipment in the reactor building is qualified for service in harsh environments, such as spray, steam, or flooding. The applicant's evaluation determined that failure of non-safety-related components will not result in the failure of safety-related components in that vicinity. Electrical equipment rooms and other unique locations are considered to be the most susceptible to spray/leakage concerns. Spray-proof enclosures are used for termination boxes, splice boxes, and for field-mounted equipment like fuse relays. Field-mounted devices, such as transmitters, limit switches, solenoid valves, and valve motor operators are also designed for spray-proof. The applicant's reevaluation found that all the safety-related components and equipment have been protected for wetting concerns.

Leakage cracks are postulated to occur in moderate-energy systems. UFSAR Section 3.6.2.1.4 provides information on the CLB of postulated moderate-energy piping leakage. The applicant evaluated all non-safety-related moderate and high-energy fluid systems in the areas of concern and found that the safety-related components and equipment have been protected from wetting due to leakage.

Flooding and Leak Detection

Flooding due to large amounts of leakage from system components into nearby areas may prevent the performance of a safety function. Systems that are credited for detection and isolation of leaks to preclude adverse effects on safety-related equipment and functions are within the scope of license renewal. The structural aspects of plant design (protective/mitigative

features) that preclude an adverse impact on safety-related components due to flooding are included in scope. The applicant reviewed current flooding analysis and plant design documents and concluded that no other SSCs needed to be included in the expanded scope for license renewal per refined Criterion 2.

As a result of this reevaluation, the applicant identified 34 systems that had their scope expanded to include non-safety-related systems and/or QR portions that have a potential for adverse spatial interactions with safety-related equipment in the designated buildings. With the exception of the interface between the safety-related SW system and non-safety-related CI system, the applicant found that these systems do not have to expand their scoping due to spatial effects because they are the same material and environment combination on each side of the code break. These systems were initially included in the scope of license renewal and either sides of the code break are subject to an AMR.

The interfaces between the SW system and CI system are at the supply and return valves of the RBCU. The process environment for the SW system (safety-related side of the code break) is raw water, while the CI system (non-safety-related side of the code break) is closed-cycle treated water. The SW system was included in the license renewal scope for its raw water environment, but CI piping was not selected for AMR even though the treated water is mixing with raw water. The applicant's reevaluation determined to include the CI system piping in the expended scope for license renewal and subject to AMR to meet refined Criterion 2.

Based on the above reevaluation of the plant systems, the applicant added the following non-safety-related systems to the expanded scope for license renewal due to the potential for spatial interactions with safety-related SSCs in the designated buildings:

- Condenser Air Removal (AR)
- Demineralized Water (DW)
- Fuel Oil Handling (FO)
- Hydrogen-Nuclear Plant Use (HN)
- Liquid Effluents from Nuclear Plant to Penstock (LW)
- Nuclear Blowdown Processing (NB)
- Nitrogen-Nuclear Plant Use (NN)
- Oxygen-Nuclear Plant Use (ON)
- Sewer (SE)
- RW Solidification & Solids Handling (WD)
- Excess Liquid Waste (WX)

The applicant identified the components of these systems to be subject to an AMR using a commodity approach rather than a systems approach. Systems, system portions, and components meeting only refined Criterion 2 were grouped together according to the material type and/or the environments experienced in the designated buildings. Table 1 of the technical report lists the commodities that were determined to meet refined Criterion 2 for an AMR that was not initially listed in the tables of LRA Section 2.3. Table 1 contains 17 groups of component types; each group is provided with information on material, environment, and AMP. Some of these piping systems, ventilation ductwork, and component insulations in the table were justified so that no AMP is required. These components in the table perform limited structural integrity or limited pressure boundary function instead of supporting a specific system intended function.

The staff reviewed the non-safety-related SSCs in the above specified areas to meet Criterion 2. Based on this review, the staff finds that the applicant has considered most aspects in assessing the anti-falldown components and justified the areas of concern that need no further evaluations. The reevaluation's primary focus was on piping components in the fluid systems. However, the portions of non-fluid containing mechanical system (e.g., ventilation ducts, instrument air valves, valve actuators, etc.) were not fully addressed in the report. Certain non-fluid components may not have safety functions but are spatially orientated near safety-related components, such that their failure could adversely impact the performance of an intended safety function. In a letter dated March 28, 2003, in RAI 2.3.5-1, the staff asked the applicant to explain whether any component groups that contain no fluids should be identified and reassessed to meet Criterion 2.

In its response, dated June 12, 2003, the applicant stated that piping and piping system components, ventilation ductwork, and pipe and component insulation were specifically included in the technical report. The evaluation in the technical report addresses all system piping and ductwork regardless of the internal environment (i.e., steam, treated water, raw water, gases, air, etc.). Piping and piping system components include valves, fittings, and various piping components located in the seismic portion of the piping. Ventilation ductwork includes damper housing when contained in the seismic portions of the system. Piping and component insulation was included as the portions or sections of insulation may support other sections. The applicant did not identify any non-fluid containing components that need to be added to the expended scope per refined Criterion 2.

The staff reviewed the technical report and the applicant's response and found that the applicant had included all the non-safety-related SSCs with the configuration to meet NRC guidance and Criterion 2. Based on the above review, the staff concluded that the expanded scoping and additional SSCs identified in the technical report are acceptable.

2.3.5.3 Conclusions

The staff reviewed the information in the technical report, and its confirmation from the scoping inspection and did not find any omissions in the scoping and screening of the Criterion 2 SSCs. On the basis of its review, the staff concludes that the applicant has appropriately identified the Criterion 2 systems and components that are within the scope of license renewal and the Criterion 2 systems and components that are subject to an AMR in accordance with 10 CFR 54.4(a)(2) and 10 CFR 54.21(a)(1), respectively.

2.3.5.4 References

1. Technical Report RC-02-0159, "Criteria 2 Supplement to the Application for Operation License," September 12, 2002. Adams No. ML022630347.

2. NRC Letter to Nuclear Energy Institute, "License Renewal Issue: Scoping of Seismic II/I Piping Systems," December 3, 2001. Adams No. ML013380013.

3. NRC Letter to Nuclear Energy Institute, "License Renewal Issue: Guidance on the Identification and Treatment of Structures, Systems, and Components Which Meet 10 CFR 54.4(a)(2)," March 15, 2002. Adams No. ML020770026.

4. NRC Regulatory Guide 1.29, "Seismic Design Classification."

2.4 Scoping and Screening Results: Structures

This section addresses the structures' scoping and screening results for the VCSNS license renewal application. The structures consist of the following:

- Reactor Building (Section 2.4.1)
- Other Structures (Section 2.4.2)
- Auxiliary Building (Section 2.4.2.1)
- Control Building (Section 2.4.2.2)
- Diesel Generator Building (Section 2.4.2.3)
- Fuel Handing Building (Section 2.4.2.4)
- Intermediate Building (Section 2.4.2.5)
- Turbine Building (Section 2.4.2.6)
- Service Water Pumphouse, Intake, and Discharge Structures (Section 2.4.2.7)
- Yard Structures (Section 2.4.2.8)

Pursuant to 10 CFR 54.21(a)(1) an applicant is required to identify and list SCs subject to an AMR. These are passive, long-lived SCs that are within the scope of license renewal. To verify that the applicant has properly implemented its methodology, the staff focuses its review on the implementation results. Such a focus allows the staff to confirm that there is no omission of structural components that are subject to an AMR. If the review identifies no omission, the staff has the basis to find that the applicant has identified the structural components that are subject to an AMR.

2.4.1 Reactor Building

2.4.1.1 Summary of Technical Information in the Application

The applicant describes the reactor building in LRA Section 2.4.1 and provides a list of components subject to an AMR in LRA Table 2.4-2. The reactor building is described in UFSAR Section 3.8.1, Concrete Reactor Building. The reactor building is a post tensioned, reinforced concrete structure with an integral steel liner. The reactor building consists of a cylindrical wall, a shallow dome roof, and a foundation mat with a depressed incore instrumentation pit under the reactor vessel. The foundation mat bears on fill concrete that extends to competent rock. At the underside of the reactor building foundation mat, a tendon access gallery is formed into the top of the fill concrete. A retaining wall, extending approximately one quarter (1/4) of the way around the reactor building, protects the below-grade portions of the reactor building wall from the subgrade and groundwater. Adjacent buildings surround the remaining three-quarters (3/4) of the reactor building.

The reactor building shell is post-tensioned by ungrouted tendons. The cylindrical wall employs a three-buttress, 240-degree hoop tendon concept, with 115 vertical tendons and 150 hoop tendons. The dome contains a total of 99 tendons arranged in a three-way system with 33 tendons per band.

The reactor building is lined on the inside face with a carbon steel plate liner that forms an essentially leak-tight membrane sealing the entire reactor building for any postulated conditions which may be encountered throughout the operating life of the plant. At its base, in the haunch area, a truncated conical transition section tapers inward to accommodate the thickened concrete of the cylindrical shell. A dome closes the top of the cylindrical portion of the liner. The bottom of the liner consists of flat floor liner plates welded to anchors that are embedded in the mat concrete. The liner plate extends downward into the foundation mat to line the incore instrumentation pit, the reactor building sump, the incore instrumentation pit sump, the residual heat removal sumps, and the reactor building spray sumps. The incore instrumentation pit walls are lined with carbon steel plates, while the pit bottom and the walls of the incore instrumentation tunnel sump, and reactor building spray sump floors and sidewalls are lined with stainless steel plate. Small diameter circular overlay plates are welded to the liner plate to support piping, ducts, conduit, and electric cable trays. Studs or angle anchors are provided on the liner behind the attachment plates to transfer loads on the pads into the concrete shell.

All reactor building penetrations are anchored to the concrete reactor building wall or foundation mat so that loads are transferred from the penetrations to the concrete. All penetrations satisfy the requirements of 10 CFR Part 50, Appendix J, Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors. Piping penetrations consist of a sleeve around the outside of the piping. The piping is joined to the sleeve inside the reactor building by an attachment plate. Outside the reactor building, piping is attached to the sleeve by an attachment plate or by a bellows assembly. Electrical penetration sleeves are provided to accommodate electrical and instrumentation cables that pass through the reactor building wall. The sleeves are welded to the reactor building inner reinforcing plates. The electrical leads are installed in the penetration assemblies that are bolted to the electrical penetration sleeve. Spare penetrations consist of sleeves passing through the reactor building wall with the liner reinforced around the sleeve. Both ends of the sleeve are sealed with butt-welded pipe caps.

A fuel transfer tube penetrates the reactor building connecting the refueling canal in the reactor building and the fuel transfer canal in the fuel handling building. This penetration consists of a pipe installed inside a sleeve. Two personnel airlocks are provided for access to the reactor building, each with two doors, one on the inside and one on the outside. Each door is sealed with double O-rings, which are tested and replaced when warranted by their condition. The O-rings are not long-lived components and therefore do not require an AMR. An equipment hatch, equipped with an inside-mounted hatch cover, is also provided for access to the reactor building. A concrete shield located outside the reactor building acts as a missile and biological shield. The hatch cover is sealed with double O-rings, which are tested and replaced when warranted by their condition. The O-rings are not long-lived and therefore do not require an AMR.

Table 2.4-2 lists 46 structural component groups requiring an AMR, provides a reference to the results of the AMR for each component group, and identifies the following intended functions these structural component groups provide for:

- structural and/or functional support to safety-related equipment
- structural support to non-nuclear safety-related components whose failure could prevent satisfactory accomplishment of any of the required safety-related functions

- flood protection barrier (internal and external flooding event)
- rated fire barrier to confine or retard a fire from spreading to or from adjacent areas of the plant
- pressure boundary or essentially leak tight barrier to protect public health and safety in the event of any postulated design basis events
- radiation shielding
- shielding against high energy line breaks
- spray shield or curbs for directing flow
- missile barrier (internally or externally generated)
- pipe whip restraint
- shelter/protection to safety related equipment

2.4.1.2 Staff Evaluation

The staff reviewed LRA Section 2.4.1 and UFSAR Sections 3.8.1 and 3.8.3 to determine whether the reactor building structural components within the scope of license renewal and subject to an AMR had been identified in accordance with 10 CFR 54.4 and 54.21(a)(1).

In the performance of its review, the staff selected system functions described in the UFSAR that are set forth in 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of the Rule. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted.

Table 2.4-2 lists 46 component groups that require an AMR. These component groups are:

1. anchorage
2. achorage/embedments (exposed surfaces)
3. bellows (penetration)
4. cable tray and conduit
5. cable tray and conduit supports
6. checkered plate
7. compressible joints and seals
8. control board (refuel cavity crane)
9. crane rails and girders
10. electrical and instrument panels and enclosures
11. embedments
12. equipment component supports
13. equipment hatch
14. equipment pads
15. escape air lock
16. expansion anchors

17. fire barrier penetration seals
18. fire barriers (walls, ceilings and floors)
19. fire doors
20. flood curbs (concrete)
21. flood curbs (steel)
22. flood, pressure, and specialty doors
23. foundations
24. hatches (steel)
25. HVAC duct supports
26. instrument line supports
27. instrument racks and frames
28. jet barriers (concrete and steel)
29. lead shielding supports
30. liner plate
31. metal partition walls
32. metal siding
33. missile shields
34. penetrations (mechanical and electrical)
35. personnel air lock
36. pipe supports
37. pipe whip restraint
38. post-tensioning system
39. refueling canal liner plate
40. reinforced concrete – beams, columns, floor slabs, and walls
41. seismic joint filler
42. stair, platform, and grating support
43. structural steel – beams, columns, plates, and trusses
44. sump screens
45. sumps
46. tube track

The LRA states that the scoping process to identify systems and structures that satisfy the requirements of 10 CFR 54.4(a)(1), 10 CFR 54.4(a)(2), and 10 CFR 54.4(a)(3) is performed on systems and structures using documents which form the CLB and other information sources. The CLB for the VCSNS has been defined in accordance with the definition provided in 10 CFR 54.3. The key information sources that form the CLB include the UFSAR, technical specifications, and the docketed licensing correspondence. All safety-related structures at VCSNS are designated as Seismic Category I and are within the scope of license renewal. The classification of each structure has been previously determined and documented in UFSAR Table 3.2-2, Classification of Structures.

The LRA also states that the screening process is performed on each structure identified to be within the scope of license renewal. The process is to determine whether a structure or a structural component requires an AMR in accordance with 10 CFR 54.21(a)(1).

The LRA further states that the structural components are divided into major groupings based on materials of construction and operating environment to facilitate the AMRs. For each structural component subject to AMR, the internal and external operating environments to which the component is subjected are established. Operating environments are established based on

a review of plant design documents, the UFSAR, plant drawings, and plant environmental data. For each structural component subject to AMR, the materials of construction are determined based on a review of plant design documents, the UFSAR, vendor drawings, specifications, and component databases. Components with similar design, materials of construction, functions, and subjected to similar environments are evaluated as a commodity group.

LRA Table 2.4-2 lists "Foundations" as a component type requiring an AMR, and Table 3.5-1, Item 9, as an AMR result. Table 3.5-1, Item 9, lists "reduction in foundation strength due to the erosion of porous concrete subfoundation" as an aging effect/mechanism. In a letter dated March 28, 2003, the staff requested, in RAI 2.4.1-1, to clarify what the foundations consist of and why Table 3.5-1, Item 9, is listed as an AMR result only for the reactor building but not for other buildings, such as the auxiliary building and control building, whose foundations are also supported on a fill concrete subfoundation.

In a letter dated June 12, 2003, the applicant responded to RAI 2.4.1-1 as follows:

> Table 3.5-1, Item 9, is addressed in the Application only for completeness in using the GALL tabular format and listings. Porous concrete is not used at VCSNS.
>
> 1) Fill concrete is addressed in detail in Response to RAI 3.5-6, concluding that it does not perform an intended function and does not require evaluation under any aging management programs. “Foundations” as listed in Application Table 2.4-2 include only the design structural foundations which are above the fill concrete.
>
> 2) Table 3.5-1, Item 9, is not listed as an AMR result for the Auxiliary, Control, Fuel Handling, Intermediate, Turbine, and Service Water Discharge Structures since the GALL did not identify this specific aging effect (erosion of porous concrete) in the tabular listing for “Class 1 Structures”. In alignment with the GALL, this item was only addressed under Reactor Building. [Note that only the Reactor, Auxiliary and Control Buildings have underlying fill concrete.]

The staff finds the above response acceptable.

The staff requested the applicant, in RAI 2.4.1-2, to provide justifications for the O-rings, which are used to seal the doors of two personnel airlocks and an equipment hatch, for not being subjected to an AMR.

The applicant responded to RAI 2.4.1-2 as follows:

> Containment hatches are “components” that meet the requirement of 10 CFR 54.21 (a)(1)(i) and are subject to an AMR as described in the Application. O-rings are considered as “parts” of these components and are not individually identified as meeting the requirements of 10 CFR 54.21(a)(1)(ii). Regardless, aging management of containment hatches (including all parts) is required to meet 10 CFR 50 Appendix J; therefore, implementation is under the Appendix J Leak Rate Testing Program (Application Appendix B.1.12). Plant procedures require that hatch seal leakage be tested within seven days following any door operation to ensure that containment integrity is achieved, thus ensuring functional integrity of the seals.

The staff finds the above response acceptable.

LRA Table 2.4-2 lists "Anchorage," "Anchorage/Embedments (exposed surfaces)," and “Embedments” as component types requiring AMR. The first half of the component type Anchorage/Embedments is Anchorage, which is identical to the component type Anchorage, and the second half is identical to the component type Embedments. The staff requested the applicant, in RAI 2.4.1-3, to describe each of the component types.

The applicant responded to RAI 2.4.1-3 as follows:

> At VCSNS, general definitions of these component types are as follows:
> 1) Anchorage - Cast in-place anchor bolts.
> 2) Anchorage / Embedments (exposed surfaces) - Includes support bearing plates, other anchor bolts such as Hilti Bolts or embedments for attachment such as Unistrut. 3) Embedments - Flat plates embedded in concrete surfaces (walls, ceilings, etc.) which are anchored with Nelson Studs. Flat plates are used as attachment plates for welded supports.

The staff finds the above response acceptable.

The staff requested the applicant, in RAI 2.4.1-4, to identify whether there is any masonry block wall in the reactor building.

The applicant responded, that there are no masonry block walls in the Reactor Building. The staff finds the above response acceptable.

The staff has reviewed the information in LRA Section 2.4.1, the UFSAR, and the additional information submitted by the applicant in response to the staff's RAIs. The staff finds the responses satisfactory and that the applicant made no omissions in scoping and screening the reactor building for license renewal.

2.4.1.3 Conclusions

The staff reviewed the LRA to determine whether any SSCs within the scope of license renewal and subject to an AMR had not been identified by the applicant. No omissions were found. On the basis of this review, the staff concludes that the applicant has adequately identified the structural components of the reactor building that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has adequately identified the structural components of the reactor building that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.4.2 Other Structures

The following structures are included in Section 2.4.2:

- Auxiliary Building (including Refueling Water Storage Tank and Reactor Make-up Water Storage Tank Foundations, West Penetration Access Area, and Hot Machine Shop) (Section 2.4.2.1)
- Control Building (Section 2.4.2.2)
- Diesel Generator Building (Section 2.4.2.3)
- Fuel Handling Building (Section 2.4.2.4)
- Intermediate Building (including East Penetration Access Area) (Section 2.4.2.5)
- Turbine Building (Section 2.4.2.6)

- Service Water Pumphouse, Intake and Discharge Structures (Section 2.4.2.7)

- Yard Structures (Condensate Storage Tank Foundation, Electrical Manhole MH-2, Fire Service Pumphouse, Service Water Pond Dams and West Embankment, and North Berm) (Section 2.4.2.8)

Waterstops are used in safety related structures at construction joints located below grade to inhibit the intrusion of groundwater. Waterstops and waterproofing membrane are inaccessible and considered to be subcomponents of the concrete walls and slabs.

2.4.2.1 Auxiliary Building

2.4.2.1.1 Summary of Technical Information in the Application

The applicant describes the auxiliary building in LRA Section 2.4.2.1 and provides a list of components subject to an AMR in LRA Table 2.4-3.

The foundation system for the auxiliary building consists of a four-foot thick structural reinforced concrete mat supported by fill concrete extending down to competent rock. A waterproofing membrane is provided between the fill concrete and the structural mat. The auxiliary building is a seismic Category I structure described in UFSAR Section 3.8.4.1.2. The main auxiliary building superstructure is a reinforced concrete shear wall (box type) structure whose foundation is comprised of a reinforced concrete structural mat. The exterior walls are reinforced concrete designed to prevent damage to safety-related equipment from design basis events, such as seismic and tornado-generated missiles.

The southwestern portion of the auxiliary building supports two large tanks, the refueling water storage tank and the reactor makeup water storage tank. Concrete retaining walls provide compartmental protection from tornado generated missiles. The southeastern portion of the auxiliary building is designated the west penetration access area (WPAA), which houses the containment personnel airlock (the emergency airlock connects to the fuel handling building). The WPAA utilizes structural steel framing to support the floor slabs up to the elevation of the roof. The hot machine shop is a non-seismic Category I structure located just north of the auxiliary building. The hot machine shop is a steel-framed building with metal siding designed to withstand earthquake loads and tornado wind loads to the extent required for prevention of damage to seismic Category I structures. The north wall of the auxiliary building is separated from the hot machine shop by a seismic gap. The failure of the hot machine shop will not prevent the satisfactory accomplishment of any required safety-related functions. The hot machine shop is therefore not subject to an AMR.

Table 2.4-3 lists 39 structural component groups requiring an AMR, provides a reference to the results of the AMR for each component group, and identifies the following intended functions these structural component groups provide for:

1. structural and/or functional support to safety-related equipment

2. structural support to non-nuclear safety-related components whose failure could prevent satisfactory accomplishment of any of the required safety-related functions.

3. flood protection barrier (internal and external flooding event)

4. rated fire barrier to confine or retard a fire from spreading to or from adjacent areas of the plant

5. pressure boundary or essentially leak tight barrier to protect public health and safety in the event of any postulated design basis events

6. radiation shielding

7. shielding against high energy line breaks

8. spray shield or curbs for directing flow

9. missile barrier (internally or externally generated)

10. pipe whip restraint

11. shelter/protection to safety-related equipment

2.4.2.1.2 Staff Evaluation

The staff reviewed LRA Section 2.4.2.1 and UFSAR Sections 3.8.4.1.2, 3.8.4.4.2, and 3.8.5.1.2 to determine whether the auxiliary building structural components within the scope of license renewal and subject to an AMR had been identified in accordance with 10 CFR 54.4 and 54.21(a)(1).

The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted.

Table 2.4-3 lists 39 structural component groups that require an AMR. These component groups are:

1. anchorage
2. anchorage/embedments (exposed surfaces)
3. bellows (RHR and reactor building spray system isolation valve chambers and guard pipe)
4. blowout or blow-off panels
5. cable tray and conduit
6. cable tray and conduit supports
7. compressible joints and seals
8. crane rails and girders
9. duct banks
10. electrical and instrument panels and enclosures
11. embedments
12. equipment component supports
13. equipment pads
14. expansion anchors
15. fire barrier penetration seals

16. fire barriers (walls, ceilings and floors)
17. fire doors
18. flood curbs (concrete)
19. flood, pressure, and specialty doors
20. foundations
21. hatches (concrete)
22. HVAC duct supports
23. instrument line supports
24. instrument racks and frames
25. jet barriers
26. lead shielding supports
27. liner plate
28. masonry block, brick walls, or knockdown walls
29. metal spray shields
30. missile shields
31. pipe supports
32. pipe whip restraint
33. reinforced concrete — beams, columns, floor slabs, and walls
34. roof slabs
35. seismic joint filler
36. stair, platform, and grating support
37. structural steel – beams, columns, plates, and trusses
38. sumps
39. tube track.

LRA Table 2.2-2, Structural Scoping Results, lists the hot machine shop as in scope, and the reason for being in scope is that its intended functions are those that meet the requirements of 10 CFR 54.4(a)(2), and involve a seismic II/I concern. The staff requested the applicant, in RAI 2.4.2-1, to clarify whether the hot machine shop is in scope and requires an AMR, and, if not in scope, to provide a justification for its exclusion.

The applicant responded to RAI 2.4.2-1 as follows:

> This RAI is correct in that the Application is contradictory for including the Hot Machine Shop in scope. Application Table 2.2-2 was extracted from the VCSNS Scoping Report which identified the Hot Machine Shop as initially in scope due to the potential for seismic interaction with the Auxiliary Building. During the Screening process, it was subsequently determined that failure of the Hot Machine Shop would have an insignificant impact on the Auxiliary Building, and would not prevent satisfactory accomplishment of any safety related functions. Therefore, since it does not actually perform an intended function, it was taken out of scope.
>
> The statement in Application Section 2.4.2.1 is correct in that the failure of the Hot Machine Shop will not prevent the satisfactory accomplishment of any required safety related functions, and is thus not subject to an aging management review. Supporting Technical Reports will be revised to delete the Hot Machine Shop from the scope of license renewal.

The staff finds the above response acceptable.

The staff requested the applicant, in RAI 2.4.2-2, to identify whether the refueling water storage tank and the reactor makeup water storage tank are in scope and subject to an AMR since they are not listed in Table 2.4-3 and, if not, to provide a justification for their exclusion.

The applicant responded to RAI 2.4.2-2 as follows:

> The Refueling Water Storage Tank and the Reactor Make-Up Water Storage Tank are both in scope and included in the Application with their respective mechanical systems. The Refueling Water Storage Tank is discussed in Section 2.3.2.5 and Table 3.2-2, Items 1 and 7. The Reactor Make-Up Water Storage Tank is discussed in Section 2.3.3.18 and Table 3.3-2, Items 1 and 20.

The staff finds the above response acceptable.

The staff requested the applicant, in RAI 2.4.2-3, to indicate whether grout is subject to an AMR and, if not, provide a justification for its exclusion.

The applicant responded to RAI 2.4.2-3 as follows:

> In the Application 2.4 Tables, grout is generically included as a component type under "Equipment Pads" for each structure even though it is not specifically listed as an individual component type. In the supporting technical reports, grout is not identified as an individual commodity type, rather included under the commodity grouping of "concrete", and subject to the same AMPs.

The staff finds the above response acceptable.

The staff has reviewed the information in LRA Section 2.4.2.1, the UFSAR, and the additional information submitted by the applicant in response to the staff's RAIs. The staff finds the response satisfactory and that the applicant made no omissions in scoping and screening the auxiliary building for license renewal.

2.4.2.1.3 Conclusion

The staff reviewed the LRA to determine whether any SSCs within the scope of license renewal and subject to an AMR had not been identified by the applicant. No omissions were found. On the basis of this review, the staff concludes that the applicant has adequately identified the structural components of the auxiliary building that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has adequately identified the structural components of the auxiliary building that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.4.2.2 Control Building

2.4.2.2.1 Summary of Technical Information in the Application

The applicant describes the control building in LRA Section 2.4.2.2 and provides a list of components subject to an AMR in LRA Table 2.4-4.

The foundation system for the control building consists of a reinforced concrete mat designed to transfer vertical load from superstructure columns to fill concrete extending down to competent rock. Vertical reinforcing steel extends from exterior shear walls into fill concrete. The control building is a seismic Category I structure described in UFSAR Section 3.8.4.1.5.

The superstructure is a steel frame structure with concrete exterior shear walls containing four main floor levels and a concrete roof, and is designed to withstand the various combinations of

dead and live loads, design basis event loads, and other generic design criteria loads as defined in the UFSAR.

Table 2.4-4 lists 37 structural component groups requiring an AMR, provides a reference to the results of the AMR for each component group, and identifies the following intended functions these structural component groups provide for:

1. structural and/or functional support to safety-related equipment

2. structural support to non-nuclear safety-related components whose failure could prevent satisfactory accomplishment of any of the required safety-related functions

3. flood protection barrier (internal and external flooding event)

4. rated fire barrier to confine or retard a fire from spreading to or from adjacent areas of the plant

5. pressure boundary or essentially leak tight barrier to protect public health and safety in the event of any postulated design basis events

6. radiation shielding

7. spray shield or curbs for directing flow

8. missile barrier (internally or externally generated)

9. shelter/protection to safety-related equipment

2.4.2.2.2 Staff Evaluation

The staff reviewed LRA Section 2.4.2.2 and UFSAR Sections 3.8.4.1.5, 3.8.4.4.5, and 3.8.5.1.4 to determine whether the control building structural components within the scope of license renewal and subject to an AMR had been identified in accordance with 10 CFR 54.4 and 54.21(a)(1).

The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted.

Table 2.4-4 lists 37 structural component groups that require an AMR. These component groups are: 1. anchorage, 2. anchorage/embedments (exposed surfaces), 3. cable tray and conduit, 4. cable tray and conduit supports, 5. checkered plate, 6. compressible joints and seals, 7. control boards and panels, 8. control room ceiling, 9. crane rails and girders, 10. duct banks, 11. electrical and instrument panels and enclosures, 12. embedments, 13. equipment component supports, 14. equipment pads, 15. expansion anchors, 16. fire barrier penetration seals, 17. fire barriers (walls, ceilings and floors), 18. fire doors, 19. flood barriers (elastomers), 20. flood curbs (concrete), 21. flood, pressure, and specialty doors, 22. foundations, 23. hatches (concrete), 24. HVAC duct supports, 25. instrument line supports, 26. instrument racks and frames, 27. lead shielding supports, 28. masonry block, brick walls, or knockdown walls, 29. metal partition walls, 30. missile shields, 31. pipe supports, 32. reinforced concrete –

beams, columns, floor slabs, and walls, 33. roof slabs, 34. seismic joint filler, 35. stair, platform, and grating support, 36. structural steel – beams, columns, plates, and trusses, and 37. tube track.

The staff has reviewed the information in LRA Section 2.4.2.2, and the UFSAR. The staff finds that the applicant made no omissions in scoping and screening the control building for license renewal.

2.4.2.2.3 Conclusions

The staff reviewed the LRA to determine whether any SSCs that should be within the scope of license renewal and subject to an AMR had not been identified by the applicant. No omissions were found. On the basis of this review, the staff concludes that the applicant has adequately identified the structural components of the control building that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has adequately identified the structural components of the control building that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.4.2.3 Diesel Generator Building

2.4.2.3.1 Summary of Technical Information in the Application

The applicant describes the diesel generator building in LRA Section 2.4.2.3 and provides a list of components subject to an AMR in LRA Table 2.4-5.

The foundation system for the diesel generator building consists of a reinforced concrete slab and grade beam system that is supported by reinforced concrete caissons drilled into competent bedrock. The foundations for the diesel generators extend from the operating floor level down to the basement floor mat.

The diesel generator building is a seismic Category I structure described in UFSAR Section 3.8.4.1.4. The superstructure is a reinforced concrete shear wall (box type) structure containing three main floor levels above the foundation mat, and a roof, designed to withstand the various combinations of dead and live loads, operating-basis earthquake (OBE) and SSE seismic loads, wind loads, tornado loads, and other generic design criteria loads as defined in the UFSAR. The entire building is separated from other buildings to prevent load transfer during an OBE or SSE.

The primary function of the diesel generator building is to house the diesel generators that are needed to supply emergency onsite power in the event that offsite power is lost. The diesel generator building is designed to withstand the various combinations of dead and live loads, design basis event loads, and other generic design criteria loads as defined in the UFSAR.

Table 2.4-5 lists 34 structural component groups requiring an AMR, provides a reference to the results of the AMR for each component group, and identifies the following intended functions these structural component groups provide for:

1. structural and/or functional support to safety related equipment

2. structural support to non nuclear safety-related components whose failure could prevent satisfactory accomplishment of any of the required safety-related functions

3. flood protection barrier (internal and external flooding event)

4. rated fire barrier to confine or retard a fire from spreading to or from adjacent areas of the plant

5. spray shield or curbs for directing flow

6. missile barrier (internally or externally generated)

7. shelter/protection to safety-related equipment

2.4.2.3.2 Staff Evaluation

The staff reviewed LRA Section 2.4.2.3 and UFSAR Sections 3.8.4.1.4, 3.8.4.4.4, and 3.8.5.1.6 to determine whether the structural components of the diesel generator building within the scope of license renewal and subject to an AMR had been identified in accordance with 10 CFR 54.4 and 54.21(a)(1).

The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted.

Table 2.4-5 lists 34 structural component groups that require an AMR. These component groups are 1. anchorage, 2. anchorage/embedments (exposed surfaces), 3. cable tray and conduit, 4. cable tray and conduit supports, 5. caissons, 6. compressible joints and seals, 7. crane rails and girders, 8. duct banks, 9. electrical and instrument panels and enclosures, 10. embedments, 11. equipment component supports, 12. equipment pads, 13. expansion anchors, 14. fire barrier penetration seals, 15. fire barriers (walls, ceilings and floors), 16. fire doors, 17. flood barriers (elastomers), 18. flood curbs (concrete), 19. flood, pressure, and specialty doors, 20. foundations, 21. grating, 22. hatches (steel), 23. HVAC duct supports, 24. instrument line supports, 25. instrument racks and frames, 26. metal partition walls, 27. missile shields, 28. pipe supports, 29. reinforced concrete – beams, columns, floor slabs, and walls, 30. roof slabs, 31. seismic joint filler, 32. stair, platform, and grating support, 33. structural steel – beams, columns, plates, and trusses, and 34. sumps.

The staff has reviewed the information in LRA Section 2.4.2.3 and the UFSAR. The staff finds that the applicant made no omissions in scoping and screening the Diesel generating building for license renewal.

2.4.2.3.3 Conclusion

The staff reviewed the LRA to determine whether any SSCs within the scope of license renewal and subject to an AMR had not been identified by the applicant. No omissions were found. On the basis of this review, the staff concludes that the applicant has adequately identified the structural components of the diesel generating building that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has adequately identified the

structural components of the diesel generating building that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.4.2.4 Fuel Handling Building

2.4.2.4.1 Summary of Technical Information in the Application

The applicant describes the fuel handling building in LRA Section 2.4.2.4 and provides a list of components subject to an AMR in LRA Table 2.4-6.

The foundation system for the fuel handling building consists of a reinforced concrete mat formed by the bottom of the spent fuel pool and fuel cask pit and supported by reinforced concrete piers that extend to the fill concrete adjacent to the reactor and auxiliary buildings, and by reinforced concrete caissons that extend to competent rock on the north and east sides.

The fuel handling building is a Seismic Category I structure discussed in UFSAR Section 3.8.4.1.6. The superstructure is a steel frame structure containing two main floor levels and a roof, designed to withstand the various combinations of dead and live loads, design basis event loads, and other generic design criteria loads as defined in the UFSAR.

Table 2.4-6 lists 40 structural component groups requiring an AMR, provides a reference to the results of the AMR for each component group, and identifies the following intended functions these structural component groups provide for:

1. structural and/or functional support to safety-related equipment

2. structural support to non-nuclear safety-related components whose failure could prevent satisfactory accomplishment of any of the required safety-related functions

3. pressure boundary or essentially leak tight barrier to protect public health and safety in the event of any postulated design basis events

4. flood protection barrier (internal and external flooding event)

5. radiation shielding

6. rated fire barrier to confine or retard a fire from spreading to or from adjacent areas of the plant

7. spray shield or curbs for directing flow

8. missile barrier (internally or externally generated)

9. shelter/protection to safety related equipment

2.4.2.4.2 Staff Evaluation

The staff reviewed LRA Section 2.4.2.4 and UFSAR Sections 3.8.4.1.6, 3.8.4.4.6, and 3.8.5.1.5 to determine whether the fuel handling building structural components within the scope of

license renewal and subject to an AMR had been identified in accordance with 10 CFR 54.4 and 54.21(a)(1).

The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted.

Table 2.4-6 lists 40 structural component groups that require an AMR. These component groups are: 1. anchorage, 2. anchorage/embedments (exposed surfaces), 3. cable tray and conduit, 4. cable tray and conduit supports, 5. caissons, 6. checkered plate, 7. compressible joints and seals, 8. crane rails and girders, 9. electrical and instrument panels and enclosures, 10. embedments, 11. equipment component supports, 12. equipment pads, 13. expansion anchors, 14. fire barrier penetration seals, 15. fire barriers (walls, ceilings and floors), 16. fire doors, 17. flood curbs (concrete), 18. foundations, 19. fuel transfer canal liner plate, 20. hatches (concrete), 21. hatches (steel), 22. HVAC duct supports, 23. instrument line supports, 24. instrument racks and frames, 25. lead shielding supports, 26. masonry block, brick walls, or knockdown walls, 27. metal siding, 28. missile shields, 29. neutron absorbing sheets in spent fuel pool—boraflex, 30. piers (concrete), 31. pipe supports, 32. reinforced concrete — beams, columns, floor slabs, and walls, 33. roof, 34. seismic joint filler, 35. spent fuel pool liner, 36. spent fuel storage rack, 37. stair, platform, and grating support, 38. structural steel - beams, columns, plates, and trusses, 39. sumps, and 40. tube track.

The staff has reviewed the information in LRA Section 2.4.2.2 and the UFSAR. The staff finds that the applicant made no omissions in scoping and screening the fuel handling building for license renewal.

2.4.2.4.3 Conclusions

The staff reviewed the LRA to determine whether any SSCs within the scope of license renewal and subject to an AMR had not been identified by the applicant. No omissions were found. On the basis of this review, the staff concludes that the applicant has adequately identified the structural components of the fuel handling building that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has adequately identified the components of the fuel handling building that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.4.2.5 Intermediate Building

2.4.2.5.1 Summary of Technical Information in the Application

The applicant describes the intermediate building in LRA Section 2.4.2.5 and provides a list of components subject to an AMR in LRA Table 2.4-7.

The foundation system for the intermediate building consists of a reinforced concrete basement floor slab that acts in conjunction with a series of grade beams to transfer vertical loads to the reinforced concrete caissons, shear/bearing walls, and concrete piers. The shear/bearing wall foundations and reinforced concrete caissons are founded on competent bedrock. The piers are founded on fill concrete that extends beyond the reactor building and auxiliary building. Horizontal shears are transferred through the basement floor slab to the shear/bearing walls and to the control building base mat.

The intermediate building is a seismic Category I structure described in UFSAR Section 3.8.4.1.3. The superstructure is an L-shaped reinforced concrete shear wall (box type) structure containing two main floor levels above the foundation and extending up to the low roof. Above the low roof is a partial third floor of reinforced concrete and a high roof. The intermediate building is designed to withstand the various combinations of dead and live loads, design basis event loads, and other generic design criteria loads as defined in the UFSAR.

Table 2.4-7 lists 42 structural component groups requiring an AMR, provides a reference to the results of the AMR for each component group, and identifies the following intended functions these structural component groups provide for:

- structural and/or functional support to safety-related equipment
- structural support to non-nuclear safety-related components whose failure could prevent satisfactory accomplishment of any of the required safety-related functions
- flood protection barrier (internal and external flooding event)
- rated fire barrier to confine or retard a fire from spreading to or from adjacent areas of the plant
- pressure boundary or essentially leak tight barrier to protect public health and safety in the event of any postulated design basis events
- radiation shielding
- shielding against high energy line breaks
- spray shield or curbs for directing flow
- missile barrier (internally or externally generated)
- pipe whip restraint
- shelter/protection to safety-related equipment

2.4.2.5.2 Staff Evaluation

The staff reviewed LRA Section 2.4.2.5 and UFSAR Sections 3.8.4.1.3, 3.8.4.4.3, and 3.8.5.1.3 to determine whether the intermediate building structural components within the scope of license renewal and subject to an AMR had been identified in accordance with 10 CFR 54.4 and 54.21(a)(1).

In the performance of its review, the staff selected system functions described in the UFSAR that were set forth in 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of the Rule. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted.

Table 2.4-7 lists 42 structural component groups that require an AMR. These component groups are 1. anchorage, 2. anchorage/embedments (exposed surfaces), 3. battery racks, 4. blowout or blow-off panels, 5. cable tray and conduit, 6. cable tray and conduit supports, 7. caissons, 8. compressible joints and seals, 9. crane rails and girders, 10. duct banks, 11. electrical and instrument panels and enclosures, 12. embedments, 13. equipment component supports, 14. equipment pads, 15. expansion anchors, 16. fire barrier penetration seals, 17. fire barriers (walls, ceilings and floors), 18. fire doors, 19. flood curbs (concrete), 20. flood, pressure, and specialty doors, 21. foundations, 22. hatches (concrete), 23. hatches (steel), 24. HVAC duct supports, 25. instrument line supports, 26. instrument racks and frames, 27. jet barriers, 28. lead shielding supports, 29. metal siding, 30. metal spray shields, 31. missile shields, 32. piers, 33. pipe supports, 34. pipe whip restraint, 35. reinforced concrete — beams, columns, floor slabs, and walls, 36. roof slabs, 37. seismic joint filler, 38. stair, platform, and grating support, 39. structural steel—beams, columns, plates, and trusses, 40. sumps, 41. trenches, and 42. tube track.

The staff has reviewed the information in LRA Section 2.4.2.5. The staff finds that the applicant made no omissions in scoping and screening the intermediate building for license renewal.

2.4.2.5.3 Conclusion

The staff reviewed the LRA to determine whether any SSCs within the scope of license renewal and subject to an AMR had not been identified by the applicant. No omissions were found. On the basis of this review, the staff concludes that the applicant has adequately identified the structural components of the intermediate building that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has adequately identified the structural components of the intermediate building that are subject to an aging management review, as required by 10 CFR 54.21(a)(1).

2.4.2.6 Turbine Building

2.4.2.6.1 Summary of Technical Information in the Application

The applicant describes the turbine building in LRA Section 2.4.2.6 and provides a list of components subject to an AMR in LRA Table 2.4-8.

The foundation mat for the turbine building is comprised of a reinforced concrete mat supported by Zone III fill (graded crushed stone) material. The reinforced concrete pedestal foundation mats for the feedwater pumps and turbine generators are founded on fill concrete over bedrock. The turbine building is a non-seismic Category I structure as described in UFSAR Section 3.8.4.1.1. The superstructure of steel framing, metal siding, and metal roof deck is supported on a reinforced concrete substructure. The steel rigid frame structure is elastically supported at the operating floor, which acts as a diaphragm. The subsurface portion of the east, west, and south walls are reinforced concrete. The north wall is structural steel framing, with no siding, that abuts the control, intermediate, and diesel buildings. The entire building is separated from other buildings to prevent load transfer during seismic events.

The turbine building is designed to withstand the various combinations of dead and live loads, seismic loads, wind loads, tornado loads, and other generic design criteria loads as defined in the UFSAR. However, for earthquake loads and tornado wind loads, the turbine building is only

designed to the extent required to prevent damage to seismic Category I structures. The primary function of the turbine building is to house the turbine generators. The functional requirement of the building in the event of an earthquake or tornado is that no portion of the building collapses and results in damage to seismic Category I structures.

Table 2.4-8 lists 34 structural component groups requiring an AMR, provides a reference to the results of the AMR for each component group, and identifies the following intended functions these structural component groups provide for:

- structural support to non-nuclear safety-related components whose failure could prevent satisfactory accomplishment of any of the required safety-related functions
- flood protection barrier (internal and external flooding event)
- rated fire barrier to confine or retard a fire from spreading to or from adjacent areas of the plant
- pressure boundary or essentially leak tight barrier to protect public health and safety in the event of any postulated design basis events
- spray shield or curbs for directing flow
- missile barrier (internally or externally generated)
- shelter/protection to safety-related equipment
- source of cooling water

2.4.2.6.2 Staff Evaluation

The staff reviewed LRA Section 2.4.2.7 and UFSAR Section 3.8.4.1.1 to determine whether the turbine building structural components within the scope of license renewal and subject to an AMR had been identified in accordance with 10 CFR 54.4 and 54.21(a)(1).

In the performance of its review, the staff selected system functions described in the UFSAR that were set forth in 10 CFR 54.4 to verify that components having intended functions were not omitted from the scope of the Rule. The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted.

Table 2.4-8 lists 34 structural component groups that require an AMR. These component groups are 1. anchorage, 2. anchorage/embedments (exposed surfaces), 3. cable tray and conduit, 4. cable tray and conduit supports, 5. compressible joints and seals, 6. crane rails and girders, 7. duct banks, 8. electrical and instrument panels and enclosures, 9. embedments, 10. equipment component supports, 11. equipment pads, 12. expansion anchors, 13. fire barrier penetration seals, 14. fire barriers (walls, ceilings and floors), 15. fire doors, 16. flood curbs (concrete), 17. flood, pressure, and specialty doors, 18. foundations, 19. grating, 20. hatches (concrete), 21. hatches (steel), 22. HVAC duct supports, 23. instrument line supports, 24. instrument racks and frames, 25. masonry block, brick walls, or knockdown walls, 26. metal siding, 27. pipe supports, 28. reinforced concrete — beams, columns, floor slabs, and

walls, 29. roof, 30. seismic joint filler, 31. stair, platform, and grating support, 32. structural steel — beams, columns, plates, and trusses, 33. sumps, and 34. trenches.

The staff has reviewed the information in LRA Section 2.4.2.2 and the UFSAR. The staff finds that the applicant made no omissions in scoping and screening the turbine building for license renewal.

2.4.2.6.3 Conclusions

The staff reviewed the LRA to determine whether any SSCs within the scope of license renewal and subject to an AMR had not been identified by the applicant. No omissions were found. On the basis of this review, the staff concludes that the applicant has adequately identified that the structural components of the turbine building that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has adequately identified the components of the turbine building that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.4.2.7 Service Water Pumphouse, Intake, and Discharge Structures

2.4.2.7.1 Summary of Technical Information in the Application

The applicant describes the service water pumphouse, intake, and discharge structures in LRA Section 2.4.2.7 and provides a list of components subject to an AMR in LRA Table 2.4-9.

<u>Service Water Pumphouse</u>

The foundation for the service water pumphouse consists of a reinforced concrete structural mat. The discharge pipe pits on the south side and the control areas on the west side of the service water pumphouse are supported by buried reinforced concrete columns, which extend to the supporting foundation mat. The entire structural mat is supported on compact fill that is in turn supported on a layer of in-situ soils (saprolite), then decomposed rock down to competent rock. The service water pumphouse is a seismic Category I structure described in UFSAR Section 3.8.4.1.7. The superstructure is a reinforced concrete building separated from the service water intake structure and from buried connecting pipes and electrical duct banks by flexible joints, which accommodate relative settlement and seismic movement.

The service water pumphouse is designed to withstand the various combinations of dead and live loads, OBE and SSE seismic loads, wind loads, tornado loads, and other generic design criteria loads as defined in the UFSAR. The primary function of the service water pumphouse is to house the service water pumps that pump water from the service water pond to supply the service water system. The service water pumphouse is designed to withstand the various combinations of dead and live loads, design basis event loads, and other generic design criteria loads as defined in the UFSAR.

<u>Service Water Intake And Discharge Structures</u>

Service Water Intake Structure:

The foundation for the service water intake structure consists of a reinforced concrete mat supported by compacted fill material, except for a portion of the inlet end, which rests on in-situ soils.

The service water intake structure is a seismic Category I structure as described in UFSAR Section 3.8.4.1.8. The structure is a reinforced concrete rectangular box culvert with two reinforced concrete wing walls at the intake end. The foundation mat forms the floor of the structure. An expansion joint separates the service water intake structure from the service water pumphouse, which accommodates relative settlement and seismic movement. The structure extends into the service water pond and is mostly buried in the west embankment except for the intake end, which is submerged within the pond.

The service water intake structure is designed to withstand the various combinations of dead loads, OBE and SSE seismic loads, and other generic design criteria loads as defined in the UFSAR. The primary function of the service water intake structure is to extend the point at which water is drawn from the service water pond into the service water pumphouse. The functional requirement of the service water intake structure during and following a design basis event is that it does not collapse and result in a loss of supply water from the service water pond to the service water pumphouse.

Service Water Discharge Structure:

The foundation for the service water discharge structure consists of a reinforced concrete mat that bears partly on decomposed rock and partly on fill concrete that extends to the decomposed rock. The service water discharge structure is a seismic Category I structure as described in UFSAR Section 3.8.4.1.9. The structure is a reinforced concrete rectangular basin mostly buried in the west embankment of the service water pond. The foundation mat forms the floor of the basin. A 15-foot high abutment wall forms the west end of the basin, and a 3-foot high sill wall forms the east end. Wing walls form the north and south sides of the basin. Two 30-inch diameter service water pipes terminate at the abutment wall and are connected to the service water discharge structure by flexible connections.

The service water discharge structure is designed to withstand the various combinations of dead loads, OBE and SSE seismic loads, and other generic design criteria loads as defined in the UFSAR. The primary function of the service water discharge structure is to release service water into the service water pond. The functional requirement of the service water discharge structure during and following a design basis event is that it does not collapse and result in an interruption of service water discharge.

Table 2.4-9 lists 34 structural component groups requiring an AMR, provides a reference to the results of the AMR for each component group, and identifies the following intended functions these structural component groups provide for:

- structural and/or functional support to safety-related equipment
- structural support to non-nuclear safety-related components whose failure could prevent satisfactory accomplishment of any of the required safety-related functions
- flood protection barrier (internal and external flooding event)

- rated fire barrier to confine or retard a fire from spreading to or from adjacent areas of the plant
- spray shield or curbs for directing flow
- missile barrier (internally or externally generated)

2.4.2.7.2 Staff Evaluation

The staff reviewed LRA Section 2.4.2.8 and UFSAR Sections 3.8.4.1.7, 3.8.4.1.8, 3.8.4.1.9, 3.8.4.4.7, 3.8.4.4.8, 3.8.4.4.9, 3.8.5.1.7, 3.8.5.1.8, and 3.8.5.1.9 to determine whether the components of the service water pumphouse, intake, and discharge structures within the scope of license renewal and subject to an AMR had been identified in accordance with 10 CFR 54.4 and 54.21(a)(1).

The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted.

Table 2.4-9 lists 34 structural component groups that require an AMR. These component groups are 1. anchorage, 2. anchorage/embedments (exposed surfaces), 3. cable tray and conduit, 4. cable tray and conduit supports, 5. checkered plate, 6. compressible joints and seals, 7. crane rails and girders, 8. duct banks, 9. electrical and instrument panels and enclosures, 10. embedments, 11. equipment component supports, 12. equipment pads, 13. expansion anchors, 14. fire barrier penetration seals, 15. fire barriers (walls, ceilings and floors), 16. fire doors, 17. flood curbs (concrete), 18. flood, pressure, and specialty doors, 19. foundations, 20. grating, 21. hatches (concrete), 22. HVAC duct supports, 23. instrument line supports, 24. instrument racks and frames, 25. intake bays or canals, 26. intake screens, 27. missile shields, 28. pipe supports, 29. reinforced concrete — beams, columns, floor slabs, and walls, 30. roof slab, 31. seismic joint filler, 32. stair, platform, and grating support, 33. structural steel — beams, columns, plates, and trusses, and 34. sumps.

The staff has reviewed the information in LRA Section 2.4.2.2 and the UFSAR. The staff finds that the applicant made no omissions in scoping and screening the service water intake and discharge structures for license renewal.

2.4.2.7.3 Conclusions

The staff reviewed the LRA to determine whether any SSCs that should be within the scope of license renewal and subject to an AMR had not been identified by the applicant. No omissions were found. On the basis of this review, the staff concludes that the applicant has adequately identified the structural components of the service water intake and discharge structures are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has adequately identified the components of the service water intake and discharge structures that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.4.2.8 Yard Structures

2.4.2.8.1 Summary of Technical Information in the Application

The applicant describes the yard structures in LRA Section 2.4.2.8 and provides a list of components subject to an AMR in LRA Table 2.4-10.

The following structures are included in yard structures:

- Condensate Storage Tank Foundation
- Fire Service Pumphouse
- Electrical Manhole MH-2
- Earthen Embankments (Service Water Pond Dams, West Embankment, North Berm)
- Electrical Substation and Relay House

Condensate Storage Tank Foundation

The foundation for the condensate storage tank is designed to satisfy seismic Category I requirements as defined in UFSAR Sections 2.5.4.10.3 and 9.2.6. The foundation consists of a reinforced concrete mat supported by Zone III (graded crushed stone) fill material and an integral reinforced concrete ring wall that extends above the top of the foundation mat. The condensate storage tank is secured to the foundation by anchor bolts embedded in the ring wall. The interior area of the ring wall is filled with clean dry sand to form a sand mat beneath the tank. A reinforced concrete valve pit for the condensate storage tank drainpipe is integrated into the south side of the foundation.

The primary function of the condensate storage tank foundation is to support the nuclear safety-related condensate storage tank. The functional requirement of the foundation during and following a design basis event is that its failure would not result in a loss of the condensate storage tank contents.

Table 2.4-10 lists 11 structural component groups requiring an AMR, provides a reference to the results of the AMR for each component group, and identifies the following intended functions provided for by these structural component groups:

- structural and/or functional support to safety-related equipment

- structural support to non nuclear safety-related components whose failure could prevent satisfactory accomplishment of any of the required safety-related functions

Fire Service Pumphouse

The fire service pumphouse is a concrete block building described in the FPER Section 4.10. The building is founded upon the reinforced concrete circulating water intake structure. Hollow concrete blocks are used to form the exterior and interior walls of the building, and solid concrete blocks are used under steel framing members. The composite roof is a built-up insulated roof with gravel over steel decking and metal roof trusses. A reinforced concrete slab, located on the east side of the fire service pumphouse and founded upon the circulating water intake structure, is the foundation for the diesel engine-driven fire service pump fuel oil tank. The tank is secured to the foundation by embedded anchor bolts. The primary function of the fire service pumphouse is to house one electric motor-driven fire pump and one diesel engine-driven fire pump.

Table 2.4-11 lists 25 structural component groups requiring an AMR, provides a reference to the results of the AMR for each component group, and identifies the following intended functions provided for by these structural component groups:

- structural support to non-nuclear safety-related components whose failure could prevent satisfactory accomplishment of any of the required safety-related functions
- flood protection barrier (internal and external flooding event)
- rated fire barrier to confine or retard a fire from spreading to or from adjacent areas of the plant
- spray shield or curbs for directing flow

Electrical Manhole MH-2

The below-grade foundation for electrical manhole MH-2 consists of a reinforced concrete mat supported by Zone I and II (earthen) fill material. The reinforced concrete exterior walls are set in from the profile of the foundation mat and extend above finished grade. The manhole is divided into two compartments by a reinforced concrete partition wall installed on the east-west axis. The above-grade manhole cover is a reinforced concrete slab, containing two manways with galvanized steel covers for access into the manhole compartments. Electrical manhole MH-2 is a non-seismic structure described in FPER Section 4.9. The structure contains nuclear safety-related Class 1E and non-nuclear safety-related electrical cables.

Table 2.4-12 lists 5 structural component groups requiring an AMR, provides a reference to the results of the AMR for each component group, and identifies the following intended functions provided for by these structural component groups:

- structural and/or functional support to safety-related equipment
- structural support to non-nuclear safety-related components whose failure could prevent satisfactory accomplishment of any of the required safety-related functions
- flood protection barrier (internal and external flooding event)
- rated fire barrier to confine or retard a fire from spreading to or from adjacent areas of the plant
- shelter/protection to safety-related equipment
- missile barrier (internally or externally generated)

Earthen Embankments

Service Water Pond Dams and West Embankment:

Four earthen embankments—three dams (north dam, south dam, and east dam) and the west embankment—form the service water pond, a safety class impoundment. These homogeneous

earth structures are seismic Category I and are designed to satisfy the intent of RGs 1.27 and 1.29.

The three dams and the west embankment, which merges with the west abutments of the north and south dams, are designed to be stable under static and dynamic conditions, OBE and SSE seismic loads, and for maximum wave run-up from the Monticello Reservoir as defined in UFSAR Section 2.5.6.1. The primary function of the earthen structures is to form the service water pond, which provides water for the service water system under normal and emergency conditions. The functional requirement, assuming a loss of the Monticello Reservoir during a design basis event, is that no dam or embankment failure would result in a loss of cooling water to the service water system.

North Berm:

The shoreline along Monticello Reservoir north of the plant and west of the north dam has an earthen dike (the north berm) constructed three feet above site grade. The north berm is classified as a nonseismic, non-nuclear safety-related structure whose primary function is to protect the site from external flooding. The functional requirement of the north berm is to protect nuclear SCs from any adverse effects due to flooding. Further description of the north berm is provided in UFSAR Sections 2.4.3, 2.4.3.6.2, and 2.4.10.

Table 2.4-13 lists two structural component groups requiring an AMR, provides a reference to the results of the AMR for each component group, and identifies the following intended functions provided for by these structural component groups:

- flood protection barrier (internal and external flooding event)
- source of cooling water
- impound water

<u>Electrical Substation and Transformer Area</u>

Components that are part of the plant system portion of the offsite power grid are within the scope of license renewal in accordance with the SBO scoping criterion, 10 CFR 54.4(a)(3). This power path includes portions of the power path from the power circuit breaker (PCB) in the substation to the safety-related buses. The power path includes (1) portions of the 230 kV substation system, and (2) portions of the Parr-Summer Safeguard 115 kV system. The electrical substation provides structural support and/or shelter to components relied on during an SBO event. The electrical substation yard, located south of the turbine building, contains power circuit breakers, transformers, buslines, and electrical switching equipment. The transformer area within the site-protected area is treated as part of the electrical substation for license renewal purposes.

The entire surface of the electrical substation and transformer area, with the exception of the paved roadways, is covered with several inches of “crusher run” stone and is enclosed by a perimeter fence. Bus line and insulator supports are constructed of galvanized structural steel mounted on concrete footings. Power circuit breakers, transformers, and other electrical equipment are supported on concrete pads.

Table 2.4-14 lists 10 structural component groups requiring an AMR, provides a reference to the results of the AMR for each component group, and identifies the following intended function provide these structural component groups:

- structural support to non-nuclear safety-related components whose failure could prevent satisfactory accomplishment of any of the required safety-related functions

2.4.2.8.2 Staff Evaluation

The staff reviewed LRA Section 2.4.2.8 and UFSAR Section 3.8.4 to determine whether the yard structures components within the scope of license renewal and subject to an AMR had been identified in accordance with 10 CFR 54.4 and 54.21(a)(1).

The staff also focused on components that were not identified as being subject to an AMR to determine if any components were omitted.

Table 2.4-10 lists 11 structural component groups that require an AMR. These component groups are 1. anchorage, 2. anchorage/embedments (exposed surfaces), 3. checkered plate, 4. expansion anchors, 5. foundation dowels, 6. foundations, 7. instrument line supports, 8. instrument racks and frames, 9. pipe supports,10. reinforced concrete — beams, columns, floor slabs, and walls, and 11. stair, platform, and grating support.

Table 2.4-11 lists 25 structural component groups that require an AMR. These component groups are 1. anchorage, 2. anchorage/embedments (exposed surfaces), 3. battery racks, 4. cable tray and conduit, 5. cable tray and conduit supports, 6. electrical and instrument panels and enclosures, 7. embedments, 8. equipment component supports, 9. equipment pads, 10. expansion anchors, 11. fire barrier penetration seals, 12. fire barriers (walls, ceilings and floors), 13. fire doors, 14. flood curbs (concrete), 15. foundations, 16. hatches (steel), 17. HVAC duct supports, 18. instrument line supports, 19. instrument racks and frames, 20. masonry block, brick walls, or knockdown walls, 21. pipe supports, 22. reinforced concrete — beams, columns, floor slabs, and walls, 23. structural steel—beams, columns, plates, and trusses, 24. sumps, and 25. trenches.

Table 2.4-12 lists 5 structural component groups that require an AMR. These component groups are 1. foundations, 2. manhole covers, 3. manholes, 4. missile shields, and 5. reinforced concrete — beams, columns, floor slabs, and walls.

Table 2.4-13 lists 2 structural component groups that require an AMR. These component groups are 1. service water pond dams (north dam, south dam, and east dam) and west embankment, and 2. north berm.

Table 2.4-14 lists 10 structural component groups that require an AMR. These component groups are 1. anchorage, 2. anchorage/embedments (exposed surfaces), 3. cable tray and conduit, 4. cable tray and conduit supports, 5. electrical and instrument panels and enclosures, 6. embedments, 7. equipment component supports, 8. equipment pads (buslines, PCBs, and transformers), 9. reinforced concrete — foundations and walls, 10. structural steel—beams, columns, plates, and trusses (transmission towers).

The staff has reviewed the information in LRA Section 2.4.2.2 and the UFSAR. The staff finds that the applicant made no omissions in scoping and screening the yard structure for license renewal.

2.4.2.8.3 Conclusions

The staff reviewed the LRA to determine whether any SSCs within the scope of license renewal and subject to an AMR had not been identified by the applicant. No omissions were found. On the basis of this review, the staff concludes that the applicant has adequately identified the structural components of the yard structures that are within the scope of license renewal, as required by 10 CFR 54.4(a), and that the applicant has adequately identified the components of the yard structures that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.5 Scoping and Screening Results: Electrical and Instrumentation and Control

The applicant identified electrical and I&C component commodity groups subject to an AMR in Section 2.5, "Scoping and Screening Results: Electrical and Instrumentation and Control," of the LRA. The staff reviewed this section of the LRA to determine that all electrical component commodity groups, which are subject to an AMR as required by 10 CFR 54.21(a)(3), have been identified as required by 10 CFR 54.4(a) and 10 CFR Part 54.21(a)(1).

2.5.1 Summary of Technical Information in the Application

The applicant developed a listing of electrical and I&C component commodity groups for systems and structures within the scope of license renewal as well as active/passive determinations following the guidance of NEI 95-10, Appendix B. No commodity groups, beyond those listed in Appendix B to NEI 95-10, were identified by the applicant for VCSNS.

The applicant reviewed these electrical component commodity groups (determined to be passive) to identify those that are not subject to replacement based on a limited qualified life or specified time period.

Based on its review, the applicant determined that the following electrical and I&C component commodity groups are subject to an AMR:

- insulated cables, connectors, splices, electrical penetration assemblies, and terminal blocks that are not covered by the VCSNS 10 CFR 50.49 EQ program

- high voltage electrical switchyard bus

- high voltage transmission conductors and connections

- high voltage insulators.

All other electrical and I&C component commodity groups are either (a) active (active/passive screening), (b) subject to replacement based on a qualified life or specified time period (long lived screening), or (c) not subject to an AMR because they do not perform any intended functions (scoping).

2.5.2 Staff Evaluation

Section 2.1 of the LRA, Scoping and Screening Methodology, discussed the scoping methodology as it related to the safety-related criteria pursuant to 10 CFR 54.4(a)(1), non-safety-related criteria pursuant to 10 CFR 54.4(a)(2), and regulated events pursuant to 10 CFR 54.4(a)(3). Following the determination of the systems and structures within the scope of license renewal, the applicant implemented a process for determining which components, among those systems and structures that were determined to be within scope of license renewal, would be subject to an AMR in accordance with the requirements of 10 CFR 54.21(a)(1).

2.5.2.1 Identification of Passive Components

The applicant developed a listing of passive electrical and I&C component commodity groups for systems and structures within the scope of license renewal following the guidance of NEI 95-10 (Revision 3), Appendix B. No commodity groups, beyond those listed in Appendix B to NEI 95-10 (Revision 3), were identified by the applicant for VCSNS.

Guidance of NEI-95-10, Appendix B, utilized by the applicant for active/passive screening determinations, identifies the following passive electrical and I&C component commodity groups from typical nuclear plant systems and structures:

- cables and connections, bus, electrical portions of electrical and i&c penetration assemblies (e.g., electrical penetration assembly cables and connections, connectors, electrical splices, terminal blocks, power cables, control cables, instrument cables, insulated cables, communication cables, uninsulated ground conductors, transmission conductors, isolated-phase bus, nonsegregated-phase bus, segregated-phase bus, switchyard bus)

- elements, resistance temperature detectors (RTD), sensors, thermocouples, transducers (e.g., conductivity elements, flow elements, temperature sensors, radiation sensors, watt transducers, thermocouples, RTDs, vibration probes, amp transducers, frequency transducers, power factor transducers, speed transducers, variable transducers, vibration transducers, voltage transducers) [passive for a pressure boundary, if applicable]

- high-voltage insulators (e.g., porcelain switchyard insulators, transmission line insulators)

Passive components (for which aging degradation is not readily monitored) are those that perform an intended function without moving parts or without a change in configuration or properties. As examples of passive components, 10 CFR 54.21(a)(1)(i) provides a list including, but not limited to, electrical penetrations, cables, and connections; and excluding, but not limited to, motors, diesel generators, pressure transmitters, pressure indicators, water level indicators, switchgears, cooling fans, transistors, batteries, breakers, relays, switches, power inverters, circuit boards, battery chargers, and power supplies.

The staff reviewed the above identified component commodity groups to verify that the applicant had not omitted any passive component commodity groups and the groups identified met the above defined passive screening criteria and/or examples provided in 10 CFR 54.21(a)(1)(i). The staff concluded that the above identified component commodity groups are consistent with the examples of passive components listed in 10 CFR 54.21(a)(1)(i), and are therefore considered acceptable. In addition, these component commodity groups are the same as the passive determinations described in NEI 95-10 (Revision 3), Appendix B, for component commodity groups typically found in nuclear plants in the electrical category. The staff has reviewed these NEI determinations and concluded (1) that each component commodity group identified performs its intended function without moving parts or without a change in configuration or properties, and its aging degradation is not readily monitored and (2) that these component commodity groups acceptably identify passive components pursuant to 10 CFR 54.21(a)(1)(i). Therefore, the staff agrees that the above identified subgroup of electrical component commodity groups represents the passive electrical component commodity groups that would be required to be included in an AMR if they also met scoping and long-lived screening criteria.

2.5.2.2 Identification of Components that are Passive but Not Long-Lived

From the above electrical and I&C component commodity groups determined to be passive, the applicant identified the following component commodity groups as not meeting long-lived screening criteria and thus not subject to an AMR:

- insulated cables and connections and terminal blocks that are included in the VCSNS 10 CFR 50.49 EQ program

- electrical portions of electrical and I&C penetration assemblies that are included in the VCSNS 10 CFR 50.49 EQ program

A component that is not replaced either (1) on a specified interval based on the qualified life of the component or (2) periodically in accordance with a specified time period, is deemed to be “long-lived,” and therefore subject to an AMR.

Components subject to EQ aging requirements pursuant to 10 CFR 50.49(e)(5) are required to be replaced or refurbished at the end of their designated life. These components, pursuant to 10 CFR 50.49(e)(5), are subject to replacement based on a qualified life or specified time period. The applicant in the LRA indicated that the above identified components are included in its 10 CFR 50.49 EQ program and subject to aging requirements of 10 CFR 50.49(e)(5). The staff, therefore, agrees that the above identified components do not meet long-lived screening criteria and are thus not subject to an AMR.

2.5.2.3 Identification of Components Not Within the Scope of License Renewal

In its review, the staff noted that the applicant had not identified the following passive component commodity groups as within the scope of 10 CFR 54.4(a):

- uninsulated ground conductors

- isolated-phase bus, nonsegregated-phase bus, segregated-phase bus

- elements, RTDs, sensors, thermocouples, and transducers (e.g., conductivity elements, flow elements, temperature sensors, radiation sensors, watt transducers, thermocouples, RTDs, vibration probes, amp transducers, frequency transducers, power factor transducers, speed transducers, variable transducers, vibration transducers, voltage transducers)

As part of its review, the staff requested the applicant to explain how each of these passive component commodity groups were found not to meet any of the scoping criteria of 10 CFR 54.4(a).

Elements, RTDs, Sensors, Thermocouples, and Transducers — Section 2.5 of the LRA indicates that the passive electrical component commodity group of elements, RTDs, sensors, thermocouples, and transducers (e.g., conductivity elements, flow elements, temperature sensors, radiation sensors, watt transducers, thermocouples, RTDs, vibration probes, amp transducers, frequency transducers, power factor transducers, speed transducers, variable transducers, vibration transducers, voltage transducers) that are passive because of their pressure boundary function were found not to meet any of the scoping criteria of 10 CFR 54.4(a). Consequently, Section 2.5 of the LRA indicated that this commodity group is considered outside the scope of license renewal. In a followup question, the staff requested that the response to RAI 2.5-1 (requested by letter dated March 28, 2003) be expanded to explain why this commodity group was found not to meet any of the scoping criteria of 10 CFR 54.4(a). In its response dated June 12, 2003, the applicant stated that from an electrical standpoint, the "Elements" commodity group is active, and from a pressure boundary standpoint, these elements are not pressure boundary at VCSNS, and were, thus, screened out of consideration.

Based on its review, the staff concludes that there is no omission of electrical components (or elements) at VCSNS that could maintain a pressure boundary; therefore, the screening of this "Elements" commodity group from the scope of license renewal is considered acceptable.

Isolated-phase bus, nonsegregated-phase bus, segregated-phase bus — Section 2.5 of the LRA indicates that the passive electrical component commodity group of isolated-phase bus, nonsegregated-phase bus, and segregated-phase bus were found not to meet any of the scoping criteria of 10 CFR 54.4(a). Consequently, Section 2.5 of the LRA indicated that this "Bus" commodity group is considered outside the scope of license renewal. By letter dated March 28, 2003, the staff requested, in RAI 2.5-1, the applicant to explain why this "Bus" commodity group was found not to meet any of the scoping criteria of 10 CFR 54.4(a). In its response dated June 12, 2003, the applicant stated the following:

> VCSNS has only one application for bus duct, the isolated phase bus duct from the Main Generator to the Main Power Transformer in the Generator & Main Transformer (EG) System. This application is not in scope, as it is not credited as one of the two preferred sources for providing offsite power. See response to RAI 2.5-4 for further detail. Insulated cables are credited for providing offsite ESF power. These insulated cables on the plant system portion of the offsite power grid will be included in the Non-EQ Insulated Cable and Connection Inspection Program.

In addition, in its response to RAI 2.5-4 dated June 12, 2003, the applicant stated the following:

The EG system provides for the transmission of power from the site. The handling of plant loads, which are in the LR scope, is provided by one of the two preferred paths of offsite power, which do not include system EG [reference FSAR 8.1]. The Main Generator bus is not used by either of the two preferred sources of offsite power and is isolated by the associated substation 230 KV circuit breaker OCB-8892. The main electrical generator bus is not subject to aging management because it does not meet any of the criteria In 10 CFR 54.4(a). The maln transformer is in the same category, and system EG is not relied upon for any in-scope electrical back feed in response to an SBO event. The system is therefore not in the scope of license renewal consideration.

The boundary of the plant systems portion of the offslte power grid for the two preferred sources of offsite power Is shown on a drawing, which has been furnished for your information as requested.

It should be noted that the 230KV preferred source of offsite power comes from switchyard 230KV bus 3. A mistake was made in the LRA Section 2.1.1.1.4, Table 2.2-2 [Electrical Substatlon; Transmission Towers and Foundations], and Section 2.5.4, which refer to 230KV bus 1. The correct 230KV preferred source of offslte power is 230KV bus 3.

Based on this response, the staff concludes that this “Bus” commodity group was screened out from the scope of license renewal pursuant to 10 CFR 54.4(a) as part of applicant’s electrical systems scoping review. Based on its review, the staff concludes that there is no omission of electrical bus at VCSNS. The screening of this “Bus” commodity group from the scope of license renewal pursuant to 10 CFR 54.4(a) is considered acceptable.

Uninsulated ground conductors — Section 2.5 of the LRA indicates that the passive electrical component commodity group of uninsulated ground conductors was found not to meet any of the scoping criteria of 10 CFR 54.4(a). Consequently, this commodity group was considered outside the scope of license renewal. After a series of RAIs and responses thereto, the staff found that uninsulated ground conductors are part of the VCSNS CLB. In a letter dated September 2, 2003, the applicant clarified that the uninsulated ground conductors within the EC system are considered part of the CLB for VCSNS.

However, the staff’s conclusion on this matter, based on the plant’s conformance with single failure criteria, is that no credible uninsulated ground conductor failure mode or mechanism would prevent satisfactory accomplishment of any of the safety-related functions identified in 10 CFR 54.4(a)(1)(i),(ii), or (iii). Although the unavailability or failure of the uninsulated ground conductor may increase the damage/impact to one train if a single failure occurs, uninsulated ground conductors do not meet the non-safety-related scoping criterion of 10 CFR 54.4(a)(2). Therefore, the passive electrical commodity of uninsulated ground conductor is not within the scope of license renewal.

2.5.3 Conclusions

Based on its review, the staff did not find any omissions and, therefore, concludes that the applicant has identified component commodity groups of the electrical and I&C systems that are within the scope of license renewal pursuant to 10 CFR 54.21(a), and subject to an AMR pursuant to passive screening criterion 10 CFR 54.21(a)(1)(i) and the long-lived screening criterion 10 CFR 54.21(a)(1)(ii).

3 AGING MANAGEMENT REVIEW

3.0 Aging Management Review Results

V.C. Summer Nuclear Station (VCSNS) fully utilized the Generic Aging Lessons Learned (GALL) process found in NUREG-1801, "Generic Aging Lessons Learned (GALL) Report." The purpose of the GALL process is to provide the staff with a summary of staff-approved aging management program (AMPs) for the aging of most structures and components (SCs) that are subject to an aging management review (AMR). If an applicant commits to implementing these staff-approved AMPs, the time, effort, and resources used to review an applicant's license renewal application (LRA) will be greatly reduced, thereby improving the efficiency and effectiveness of the license renewal review process. The GALL Report is a compilation of existing programs and activities used by commercial nuclear power plants to manage the aging of SCs within the scope of license renewal and which are subject to an AMR. The GALL Report summarizes the aging management evaluations, programs, and activities credited for managing aging for most of the SCs used throughout the industry. The Report also serves as a reference for both applicants and staff reviewers to quickly identify those AMPs and activities that staff of the Nuclear Regulatory Commission (NRC) has determined will provide adequate aging management during the period of extended operation.

The GALL Report identifies (1) structures, systems, and components (SSCs), (2) component materials, (3) the environments to which the components are exposed, (4) the aging effects associated with the materials and environments, (5) the AMPs that are credited with managing the aging effects, and (6) recommendations for further applicant evaluations of aging effects and their management for certain specific components types.

In order to determine whether the GALL process would improve the efficiency of the license renewal review, the staff conducted a demonstration project to exercise the GALL process and to determine the format and content of a safety evaluation based on this process. The results of the demonstration project confirmed that the GALL process will improve the efficiency and effectiveness of the LRA review while maintaining the staff's safety focus. The standard review plan for license renewal (SRP-LR) was prepared based on both the GALL model and the lessons learned from the demonstration project.

During its review of the VCSNS LRA, the staff performed an AMR inspection from August 4-8 and 18-22, 2003. The purpose of the inspection was to examine activities that support the LRA. It consisted of a selected examination of procedures, representative records, and interviews with the applicant regarding proposed aging management activities. In addition, the inspection team reviewed the proposed implementation of all AMPs credited in the LRA for managing aging. During the AMR inspection, the staff evaluated specific issues raised by staff reviewers. On the basis of the information gathered during the inspection, the staff finds that the applicant has adequately addressed the specific issues raised by the staff reviewers. The inspection issues can be found in the staff's Inspection Report 50-395/03-08, dated September 29, 2003.

The staff also performed an AMP audit on July 16-17, 2003. The purpose of the audit was to verify the consistency of the applicant's AMPs described in the LRA with the AMPs in GALL Report. The audit team evaluated each of the 10 attributes of an applicant's AMP that the applicant claimed were consistent with the related attribute of the associated AMP described in

the GALL report. Those AMPs that were not claimed to be consistent with the GALL report, and those attributes that were deviations from the attributes described in the GALL report AMPs, were provided to the NRC staff for review. On the basis of the audit team's review of the AMPs, the staff verifies that the applicant's determination of consistency between the applicant's AMPs and the AMPs described in the GALL Report. The audit issues can be found in the staff's audit report dated October 9, 2003.

3.0.1 The GALL Format for the License Renewal Application

The VCSNS LRA closely follows the standard LRA format. However, several important changes within the format reflect the GALL process. First, the tables in LRA Section 2 that identify the SCs that are subject to an AMR now include a third column which links plant-specific SCs in the Section 2 tables to generic GALL component groups in Section 3 (this is discussed in more detail below).

Second, there are no system-specific tables in Section 3 of the VCSNS LRA. The individual components within a system have been included in a series of system group tables. For example, there are 23 auxiliary systems at VCSNS. Each system has several components. In the VCSNS LRA, there are no system tables. Instead all the components in the 23 auxiliary systems are included in one of two auxiliary system tables.

LRA Table 3.3-1 consists of auxiliary system components evaluated in the GALL Report and auxiliary system components that were not evaluated in the GALL Report, but that the applicant has determined can be managed using a GALL AMR and associated AMP. LRA Table 3.3-2 consists of VCSNS auxiliary system components that were not evaluated in the GALL Report. Similarly, the LRA tables for the other system groups (3.1 – reactor systems, 3.2 – engineered safety feature systems, 3.4 – steam and power conversion systems, 3.5 – structures, and 3.6 – electrical systems) have 3.X-1 LRA tables for components evaluated in the GALL Report and for components that were not evaluated in the GALL Report, but that the applicant has determined can be managed using a GALL AMR and associated AMP. Section 3 also includes 3.X-2 LRA tables for components that were not evaluated in the GALL Report.

The first four columns of Table 3.X-1 are derived from Tables 3.1-1 through 3.6-1 of the SRP-LR. The final column provides a discussion of (1) information regarding the applicability of the GALL Report component/commodity group to VCSNS, (2) any issues recommended in the GALL Report that require further evaluation, (3) details regarding VCSNS components to be included in the component/commodity group, and (4) a conclusion regarding consistency of the AMR with the GALL Report. A conclusion that the AMR is consistent with the GALL Report means that the combination of component material, environment, aging effect requiring management, and AMR are the same as those specified in Volume 2 of the GALL Report. VCSNS considered an AMR to be consistent with the GALL Report despite differences in the names of plant-specific components or commodities provided that the above combination of material, environment, aging effect requiring management, and AMP were the same as those identified in the GALL Report. In some cases, additional components/commodities beyond those listed in the GALL Report have been added, but only if the combination of material, environment, aging effect requiring management, and AMP were the same. In addition, plant-specific information that pertains to the evaluation of the component/commodity group has been included in the discussion column.

The 3.X-2 tables provide information regarding AMPs that are different from or not addressed in the GALL Report. The columns of these tables list component/commodity group, material, environment, aging effect/mechanism, and AMP, and include a discussion of the AMR results. The discussion typically identifies the differences from the GALL Report that form the basis for including the information in Table 3.X-2 instead of Table 3.X-1. Also, the information in these tables includes material/environment combinations that resulted in no aging effects requiring management.

3.0.2 The Staff's Review Process

The staff's review of the VCSNS LRA was performed in three phases. In Phase 1, the staff reviewed the applicant's AMP descriptions and compared those AMPs for which the applicant claimed consistency with those reviewed and approved in the GALL Report. For those AMPs for which the applicant claimed consistency with the GALL AMPs, and for which the GALL Report recommended no further evaluation, the staff conducted an audit to confirm that the applicant's AMPs were consistent with the GALL AMPs. For AMPs that were not consistent with the GALL Report, or were not addressed in GALL, the staff's review determined whether the AMPs were adequate to manage the aging effects for which they were credited.

Several VCSNS AMPs were described by the applicant as being consistent with the GALL Report, but with some deviation from GALL. By letters dated March 28, 2003, and April 9, 2003, the staff issued requests for additional information (RAI) 3.0-1, requesting the applicant to define the AMP deviations contained in the LRA. By letters dated June 12, 2003, and September 2, 2003, the applicant addressed these RAIs and follow-up staff concerns by defining the following two types of AMP deviations.

(1) Exceptions to GALL — An exception indicates that the VCSNS implementing procedure (or other document) does not achieve consistency with some element of the related GALL Chapter XI Program. Justification for the exception is provided.

(2) Enhancements to GALL — An enhancement indicates that the VCSNS implementing procedure (or other document) requires revision to achieve consistency with some element of the related GALL Chapter XI or SRP-LR Appendix A.1 Program.

For each AMP that had one or more of these deviations, the staff reviewed each deviation to determine (1) whether the deviation is acceptable, and (2) whether the AMP, as modified, would adequately manage the aging effect(s) for which it is credited.

For those AMPs that were not evaluated in the GALL Report, the staff evaluated the AMP against the 10 program elements (BTP RLSB-1 in Section A-1 of SRP-LR, Appendix A).

The staff also reviewed the final safety analysis report (FSAR) supplement for each AMP to determine whether it provided an adequate description of the program or activity, as required by Section 54.21(d) of Title 10 of the *U.S. Code of Federal Regulations (CFR)*.

The AMRs and associated AMPs in the GALL Report fall into two broad categories, (1) those AMRs and associated AMPs that GALL concludes are adequate to manage aging of the components referenced in GALL, and (2) those AMRs and associated AMPs for which GALL

concludes that aging management is adequate, but recommends further evaluation for certain aspects of the aging management process. In Phase 2, the staff compared the applicant's AMR results and associated AMPs to the AMR results and associated AMPs reviewed and approved in the GALL Report to determine their consistency. For those AMRs and associated AMPs for which GALL recommended further evaluation, the staff reviewed the applicant's evaluation to determine whether it addressed the additional issues recommended in the GALL report. Finally, for AMRs and associated AMPs that were not consistent with GALL, the staff determined whether the AMRs and associated AMPs were adequate to manage the aging effects for which they were credited.

Once it had determined that the applicant's AMPs were adequate to manage aging, the staff performed Phase 3 of its review by evaluating plant-specific SCs to determine whether the applicant had demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis (CLB) for the period of extended operation, as required by 10 CFR 54.21(a)(3). Specifically, this evaluation involved a component-by-component review to determine whether the applicant properly applied the GALL program to the aging management of components within the scope of license renewal and subject to an AMR (i.e., the staff evaluated whether the applicant had properly identified the aging effects, and the AMPs credited for managing these aging effects, for each VCSNS SC within the scope of license renewal and subject to an AMR). For SCs evaluated in the GALL Report, the staff reviewed the adequacy of aging management against the GALL criteria. For SCs not evaluated in the GALL Report, the staff reviewed the adequacy of aging management against the 10 criteria found in Appendix A of the SRP-LR. Some VCSNS SCs were not evaluated in GALL, but the applicant determined that the GALL AMR results could be applied and provided justification to support this determination. In these cases, the staff reviewed the adequacy of aging management against the GALL criteria to determine whether the GALL AMPs were adequate to manage the aging effects for which they were credited.

3.0.3 Common Aging Management Programs

Table 3.0.3-1 presents the common AMP, the associated GALL program, the system groups that credit the program for management of component aging, and the SER section that contains the staff's review of the program.

Table 3.0.3-1: Common Aging Management Programs

Applicant's AMP (LRA section)	Associated GALL AMP	LRA System Groups that Credit the AMP for Aging Management	Staff Evaluation (SER Section)
Boric Acid Corrosion Surveillance Program (B.1.2)	XI.M10	3.1 - RCS 3.2 - ESF 3.3 - AUX 3.4 - SP&C 3.5 - Civil (Structures) 3.6 - Electrical	3.0.3.1

Table 3.0.3-1: Common Aging Management Programs			
Applicant's AMP (LRA section)	**Associated GALL AMP**	**LRA System Groups that Credit the AMP for Aging Management**	**Staff Evaluation (SER Section)**
Chemistry (B.1.4)	XI.M2, XI.M30	3.1 - Reactor Systems 3.2 - ESF 3.3 - Auxiliary 3.4 - Steam and Power Conversion 3.5 - Structures	3.0.3.2
Fire Protection Program (B 1.5)	XI.M26, XI.M33	3.3 - Auxiliary 3.5 - Structures	3.0.3.3
Maintenance Rule Structures (B 1.18)	XI.S5, X1.S6	3.3 - Auxiliary 3.4 - SP&C 3.5 - Civil (Structures)	3.0.3.4
Above Ground Tank Inspection Program (B 2.1)	XI.M32	3.2 - ESF 3.3 - Auxiliary 3.4 - Steam and Power	3.0.3.5
Buried Piping and Tanks Inspection Program (B 2.10)	X1.M.34	3.3 - Auxiliary 3.4 - SP&C	3.0.3.6
Inspection for Mechanical Components Programs (B 2.11)	None	3.2 - ESF 3.3 - Auxiliary 3.4 - Steam and Power Conversion	3.0.3.7
Heat Exchanger Inspection Program (B 2.12)	X.M32, XIM33	3.3 - Auxiliary 3.4 - Steam and Power Conversion	3.0.3.8
Area Based Inspections for Refined 10CFR 54.4(a)(2) Criteria (B 2.13)	None	3.3 - Auxiliary 3.4 - Steam and Power Conversion	3.0.3.9

3.0.3.1 Boric Acid Corrosion Surveillances Program

The Boric Acid Corrosion Surveillances (BACS) Program is described in Section B.1.2 of Appendix B in the LRA. The LRA credits this surveillance program with the capability to identify leaks from borated water systems, and subsequently manage the effect of boric acid corrosion for the Virgil C. Summer Nuclear Station (VCSNS). The program monitors and assesses the condition of components that may be affected by boric acid corrosion. The staff reviewed the LRA to determine whether the applicant has demonstrated that the BACS Program will adequately manage the applicable aging effects for the components that credit this program throughout the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.0.3.1.1 Summary of Technical Information in the Application

The applicant's Boric Acid Corrosion Surveillances (BACS) Program is discussed in LRA Section B.1.2, "Boric Acid Corrosion Surveillances Program." The applicant stated that the program is consistent with GALL AMP XI.M10, "Boric Acid Corrosion," with additional surveillances to address electrical connector contacts that may be exposed to borated water leakage mentioned in Chapter VI, Item A.2.1 of the Gall report. This aging management

program (AMP) was originally implemented by the applicant in response to Generic Letter (GL) 88-05, “Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants.”

In Section B.1.2 and FSAR Supplement 18.2.7 of the LRA, the applicant described BACS Program as an existing AMP that manages loss of material due to boric acid corrosion of mechanical and structural components located in the reactor building and in specific areas of the auxiliary, intermediate, and fuel buildings where borated water leakage is possible. Further, the applicant stated that the BACS Program also manages boric acid intrusion into electrical equipment located in proximity to borated water systems. Elements of the BACS Program include the identification of leakage locations, procedures for locating small leaks, and corrective actions to ensure that boric acid corrosion does not lead to degradation of structures and components that could cause the loss of intended function.

The BACS Program is credited in the AMR tables with managing the following aging effects during the period of extended operation: (1) Loss of material due to boric acid corrosion of external surfaces of carbon steel (CS), low-alloy steel (LAS), and cast iron components; and (2) Loss of material due to boric acid corrosion and aggressive chemical attack of aluminum or brass piping and piping system components (Table 3.4-2, AMR Item 2). The following systems contain commodities/components for which this AMP is credited with managing the aging effect of loss of material: reactor coolant, auxiliary, engineered safety features, steam and power conversion, and structural and electrical systems.

In Section B.1.2 of the LRA, the applicant concluded that the Boric Acid Surveillances have been demonstrated to be capable of identifying leaks from borated water systems, and subsequently managing the effects of boric acid corrosion. The applicant also concluded that the Boric Acid Corrosion Surveillances provide reasonable assurance that the aging effects will be managed such that the components subject to aging management review will continue to perform their intended functions consistent with the current licensing basis for the period of extended operations.

By letter dated September 12, 2002, SCE&G supplemented the license renewal application for VCSNS. The letter provided the results of the additional reviews based on the NRC staff positions on scoping of seismic II/I piping systems in letters dated December 3, 2001, and March 15, 2002. As a result, VCSNS added several additional SSC's into the scope of license renewal and expanded the program description of several aging management programs including Boric Acid Surveillances program. The staff evaluation is provided below.

3.0.3.1.2 Staff Evaluation

In LRA Section B.1.2, “Boric Acid Corrosion Surveillances (BACS),” the applicant described its program to manage the effects of boric acid corrosion within the scope of license renewal. The LRA states that this program is consistent with GALL AMP XI.M10, “Boric Acid Corrosion.” The staff confirmed the applicant’s claim of consistency during an AMR Audit on July 16 - 17, 2003. The staff verified that the BACS program, as described, is consistent with GALL AMP XI.M10. Based on the consistency of this program with the GALL report, the staff focused its review on the operating history program element supporting the effectiveness of this program.

The staff reviewed the information in Section B.1.2 of Appendix B to the LRA, the summary description of the program in the FSAR supplement (Section 18.2.7 of Appendix A to the LRA), and the applicant's responses to the staff's request for additional information (RAIs). The 10 program elements in GALL AMP XI.M10, "Boric Acid Corrosion," provide detailed programmatic characteristics and criteria that the staff considers to be necessary to manage the aging effects in components. In LRA Section B.1.2, the applicant stated that the program elements for the BACS program are consistent with those specified in AMP XI.M10 of the GALL report except for enhancements related to dissimilar metal weld inspections.

[Operating Experience] In LRA Section B.1.2, the applicant stated that the BACS Program was enhanced following the incident of a weld cracking between the hot leg and RPV nozzle at VCSNS on October 7, 2000. The enhancements included provisions to ensure that all dissimilar metal welds were included in the population of components that are visually inspected at refueling outages or when appropriate plant conditions permit access. By letter dated March 28, 2003, the staff requested, in RAI B.1.2-1, the applicant to clarify the post-GALL VCSNS operating history and to discuss how the systems outside of containment will be inspected under the enhanced BACS Program.

In its response dated June 12, 2003, the applicant stated that the current BACS Program focuses on GL 88-05 requirements. The applicant also noted that GALL is driving the industry to make enhancements to the surveillances (i.e., to inspect systems outside of containment that contain boric acid solutions). In addition, recent industry events are also driving the industry to perform additional inspections. These events are described in NRC Bulletin 2002-01, "Reactor Pressure Vessel Head Degradation and Reactor Coolant Pressure Boundary Integrity," and Bulletin 2002-02, "Reactor Pressure Vessel Head and Vessel Head Penetration Nozzle Inspection Programs." The applicant stated that it intends to enhance the surveillance test procedures, required by technical specifications, for leakage of primary coolant sources outside containment (i.e., boron recycle, liquid waste, nuclear sampling, chemical and volume control, residual heat removal, and RB spray systems). In addition, the applicant stated that it also intends to enhance the leak tests performed for the SI accumulators and the spent fuel pool cooling system. These enhanced leak tests would specify inspections for boric acid crystallization on the system being tested and, in the cases when boric acid is found, also on the surrounding systems. These enhancements will be noted on the procedures and maintained as license renewal commitments. The applicant finally stated that the development of an overall Boric Acid Corrosion Program will incorporate GL 88-05 requirements, license renewal commitments, and the additional inspections that result from the NRC Bulletins. As documented in a telecommunications discussion on July 9, 2003, these enhancements are considered commitments. Applicant has agreed that this is a license renewal commitment and this commitment is documented in Appendix A of this SER.

Based on the applicant's responses to NRC Bulletins 2002-01 and 2002-02, its response to the RAI, and the discussion of enhancements to this program, the staff finds the applicant response adequate in addressing the concerns related to the detection of cracking in dissimilar metal welds. Therefore, RAI B.1.2-1 is considered closed.

By letter dated March 28, 2003, the staff requested, in RAI B.1.2-2, the applicant to list the location of the other dissimilar metal welds exposed to borated coolant to be included within the scope of the BACS Program in light of recent events. In its response dated June 12, 2003, the applicant listed the welds provided in Attachment IX to the letter from Stephen A. Byrne to the

NRC Document Control Desk, dated January 24, 2003, entitled, “Response for Additional Information Regarding 60 Day Response to NRC Bulletin 2002-01 Reactor Pressure Vessel Head Degradation and Reactor Coolant Pressure Boundary Integrity.”

The following dissimilar welds are included within the scope of the BACS Program:

- “A” hot leg weld to reactor vessel nozzle
- “A” cold leg weld to reactor vessel nozzle
- “B” hot leg weld to reactor vessel nozzle
- “B” cold leg weld to reactor vessel nozzle
- “C” hot Leg weld to reactor vessel nozzle
- “C” cold leg weld to reactor vessel nozzle
- Pressurizer surge line weld to pressurizer nozzle
- Pressurizer nozzle weld to “A” pressurizer safety valve
- Pressurizer nozzle weld to “B” pressurizer safety valve
- Pressurizer nozzle weld to “C” pressurizer safety valve
- Pressurizer nozzle weld to PORVs
- Pressurizer nozzle weld to spray piping
- “A” hot leg weld to steam generator nozzle
- “A” crossover weld to steam generator nozzle
- “B” hot leg weld to steam generator nozzle
- “B” crossover weld to steam generator nozzle
- “C” hot leg weld to steam generator nozzle
- “C” crossover weld to steam generator nozzle

Based on this response, the scope of this surveillance program includes the dissimilar welds that may be susceptible to cracking as discussed in the recent NRC Bulletins. Therefore, the staff finds the response satisfactory and considers RAI B.1.2-2 closed.

The LRA credits the BACS Program for managing loss of material due to boric acid corrosion of the pressurizer, CS and LAS components (e.g., shell, upper and lower heads, nozzles, integral support, and manway cover and bolts), the external surfaces of CS components in the RCS pressure boundary (LRA Table 3.1-1, AMR Item 26), and the steam generator (SG) elliptical head and channel head (LRA Table 2.3-7). By letter dated March 28, 2003, the staff requested, in RAIs B.1.2-3 and B.1.2-4, the applicant to discuss how the BACS Program sufficiently manages the corrosive effects of boric acid leakage on the base metal of insulated components during the extended period of operation (e.g., leakage from the pressurizer nozzle-to-vessel welds, pressurizer nozzle-to-safe end welds, and pressurizer manway bolting materials). In addition, the staff requested the applicant to discuss how the BACS Program would manage VCSNS steam generator external surfaces in light of Bulletin 2002-01, and GL 88-05, “Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components In PWR Plants.”

In its response dated June 12, 2003, the applicant stated that BACS Program will evaluate all boric acid leaks, continue to remove insulation and inspect all joints for leakage during each refueling outage, and apply corrective actions for boric acid leaks, as required, for the source and the adjacent components, supports, or structures. The applicant also referenced the response to Bulletin 2002-01 from Stephen A. Byrne of VCSNS to the NRC Document Control Desk dated January 24, 2003, as a source of further information. The staff reviewed this document and finds the detailed information provided on the inspection techniques, scope,

extent of coverage, frequency of inspections, personnel qualifications, and degree of insulation removal is adequate in addressing the staff concerns. Therefore, RAIs B.1.2-3 and B.1.2-4 are considered closed because the January 24, 2003 document describes how the BACS Program would manage the corrosive effects of boric acid leakage on the base metal of insulated components and steam generator external surfaces.

The staff reviewed the criteria 2 supplemental information in Section B.1.2, "Boric Acid Surveillances," in which the applicant credited this AMP for managing components located in the Auxiliary, Intermediate, and Fuel Handling buildings. These components are constructed of carbon steel, low-alloy steel, and other susceptible materials to loss of material due to boric acid corrosion. The applicant concluded that revisions or clarifications to the previous evaluation of this program is not needed to ensure management of these components.

The staff concurs with the applicant's conclusion because the materials of construction for these components is similar to components within the scope of this AMP. The staff notes that the scope of this AMP has been increased to include these components and finds that this AMP is adequate in managing these components for loss of material due to boric acid corrosion.

Section 18.2.7 of Appendix A to the LRA contains the applicant's FSAR supplement for the Boric Acid Corrosion Surveillances (BACS) Program. The staff reviewed this section and finds the program description consistent with the material contained in Section B.1.2 of Appendix B to the LRA, except for the reference to GL 88-05 and the enhancements to the BACS Program discussed in Section 3.0.3.1.2 of this SER. By letter dated September 2, 2003, the applicant revised the FSAR supplement to include reliance of this program on the implementation of GL 88-05, as well as subsequent NRC bulletins and guidance, to monitor the reactor coolant pressure boundary for borated water leakage. In addition, the program also includes monitoring of borated water leakage in all systems containing borated water. Based on this revision, the staff finds that the FSAR supplement provides an adequate summary of the program activities are required by 10 CFR 54.21(d).

3.0.3.1.3 Conclusions

On the basis of its review and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2 Chemistry Program

The Chemistry Program is described in Section B.1.4 of Appendix B in the LRA. The LRA credits the Chemistry Program with managing loss of material, cracking, and fouling of components exposed to borated water, closed cooling water, treated water, or fuel oil environments for the Virgil C. Summer Nuclear Station (VCSNS). The staff reviewed the LRA to determine whether the applicant has demonstrated that the Chemistry Program will

adequately manage the applicable aging effects for the components that credit this program throughout the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.0.3.2.1 Summary of Technical Information in the Application

The applicant's Chemistry Program is discussed in LRA Section B.1.4, "Chemistry Program." The applicant stated that the program is consistent with GALL AMP XI.M2, "Water Chemistry," and the chemistry-related portions of XI.M30, "Fuel Oil Chemistry," with the following clarifications concerning the detection of aging effects. The applicant indicated that the Chemistry Program is a mitigation program; therefore, no aging effects are detected as part of this program. In addition, plant operating experience confirms the effectiveness of the program for managing aging during the period of extended operation. The applicant stated that based on this experience, VCSNS does not commit to performing one-time inspections to verify the effectiveness of the Chemistry Program as recommended by the GALL AMP XI.M2.

In LRA Section B.1.4 and FSAR Supplement 18.2.10, the applicant stated that aging effects will be managed by the Chemistry Program such that the components subject to aging management review (AMR) will continue to perform their intended functions consistent with the current licensing basis (CLB) for the period of extended operations. The applicant stated that the Chemistry Program is an ongoing program that incorporates the best practices of industry organizations, vendors, utilities, and water treatment experts. This aging management program (AMP) controls the water chemistry in plant systems to minimize contaminant concentrations and adds chemicals, such as corrosion inhibitors and biocides, to manage loss of material, cracking, and fouling. The applicant noted that the Chemistry Program is based on EPRI guidelines for primary and secondary water chemistry. Analyzing and trending the water chemistry specifications has been in effect since the initial implementation at VCSNS and is considered acceptable based on industry operating experience. The Chemistry Program includes specifications for chemical species, limits, sampling and analysis frequencies, and corrective actions for primary, secondary, and auxiliary (borated or treated) water systems, as well as for oil and fuel oil.

By letter dated September 12, 3002, SCE&G supplemented the license renewal application for VCSNS. The letter provided the results of the additional reviews based on the NRC staff positions on scoping of seismic 11/1 piping sustems in letters dated December 3, 2003, and March 15, 2002. As a result, VCSNS added several additional SSC's into the scope of several aging management programs including Boric Acid Surveillances program, chemestry program and Flow-accelerated Corrosion Monitoring program. The staff evaluation is provided below.

By letter dated September 12, 2002, SCE&G supplemented the license renewal application for VCSNS. The letter provided the results of the additional reviews based on the NRC staff positions on scoping of seismic II/I piping systems in letters dated December 3, 2001, and March 15, 2002. As a result, VCSNS added several additional SSC's into the scope of license renewal and expanded the program description of several aging management programs including chemistry program. The staff evaluation is provided below.

3.0.3.2.2 Staff Evaluation

In LRA Section B.1.4, "Chemistry Program," the applicant described its program to manage the aging effects of components exposed to borated water, closed cooling water, or treated water.

The LRA states that this program is consistent with GALL AMPs XI.M2, "Water Chemistry," and the chemistry related portions of XI.M30, "Fuel Oil Chemistry." The staff confirmed the applicant's claim of consistency during the AMR Audit on July 16 - 17, 2003. The staff verified that the Chemistry Program, as described, is consistent with GALL AMPs XI.M2 and XI.M30. Based on the consistency of this program with the GALL Report, the staff focused its review on the operating history program element supporting the effectiveness of this program.

[Operating Experience] The applicant stated that a review of the operating experience did not reveal a loss of intended function for components that are exposed to borated water, closed cooling water, or treated water that could be attributed to an inadequacy of the Chemistry Program. Therefore, the applicant stated that no special one-time inspection will be performed for the purpose of verifying the effectiveness of the Chemistry Program. This position deviates from the recommendation in the GALL report for a one-time inspection in low-flow and/or stagnant areas.

By letter dated March 28, 2003, the staff requested, in RAI B.1.4-1, the applicant to clarify from operating history, recent surveillances, and inspections that cracking and crevice, general, pitting, and galvanic corrosion are adequately managed for carbon steel (CS) and stainless steel (SS) components, and cited examples from the AMR Tables. In addition, the applicant was asked to clarify if there is any inspection of the most susceptible locations (e.g., low-flow or stagnant areas) for the aging effects of loss of material, cracking, and fouling. In its response dated June 12, 2003, the applicant stated that the LRA lists the component-aging effect combination where the Chemistry Program alone is credited for aging management and presented evidence that such inspections are not required because a review of VCSNS operating experience did not reveal a loss of intended function of components that are exposed to borated water. In addition, the effects of pitting and crevice corrosion on SS components are not significant in chemically treated borated water. The staff determined that the applicant had not satisfactorily justified the effectiveness of the Chemistry Program in lieu of the one-time inspection for loss of material for CS components and requested the applicant to further discuss why the one-time inspection for low flow or stagnant locations is not needed. With respect to SS non-Class 1 RCS components, the staff notes that these components are internally exposed to chemically treated borated water and are subject to crack initiation and growth due to stress corrosion cracking (SCC). Thus, the staff found that the applicant had not adequately justified the management of cracking of non-Class 1 SS components and requested the applicant to further discuss the aging management of these components.

In subsequent correspondence dated September 2, 2003, the applicant stated that one-time inspections will be performed in low flow areas of the different chemistry regimes prior to the period of extended operation. The various chemistry regimes to be verified are found in the feedwater (FW) system, the condensate (CO) system, the emergency feedwater (EF) system, the component cooling (CC) system, the chilled water (VU) system, the local ventilation (VL) system, the air handling (AH) system, and the diesel generator services (DG) system. The FW, CO, and EF systems share one chemistry regime. The VU, VL, AH, and DG systems share another chemistry regime. Therefore, the applicant concluded that an inspection of one system per chemistry regime should be representative of the other systems. The applicant further stated that any abnormalities resulting from the visual inspection of the low flow areas will be dispositioned through engineering evaluation and addressed in site's Corrective Actions Program. If further inspections are needed, quality control inspectors will perform volumetric inspections at representative sites for the chemistry regime of the VU, VL, AH, and DG

systems. With respect to SCC of non-Class 1 SS piping, the applicant stated that Table 3.1-2, AMR Item 6, lists the aging management of both SS Class 1 and non-Class 1 components susceptible to SCC. In addition, Table 3.1-1, AMR Item 6, lists the aging management of SS Class 1 piping with the Small Bore Class 1 Piping Inspection. This inspection activity will be representative of the conditions for SS piping and components (Class 1 and non-Class 1) in borated water service.

Based on the discussion above, the staff finds the applicant's commitment to complete a one-time inspection of low flow areas of the different chemistry regimes satisfactory because it provides a method of verifying the program's effectiveness as recommended in the GALL report. With respect to the aging management of SS non-Class 1 components, the staff reviewed Table 3.1-1, AMR Item 24, which manages the aging effects of management of Class 1 SS components through the Chemistry Program and the In-Service Inspection (ISI) Plan. This AMR Item bounds the management of large bore non-Class 1 SS components. In addition, the management of non-Class 1 SS small bore piping is bounded by the Small Bore Class 1 Piping Inspection discussed in Table 3.1-1, AMR Item 6. Thus, the staff finds that the applicant will adequately manage the aging effects of SS non-Class 1 components through a combination of chemistry control and inspection. Therefore, RAI B.1.4-1 is considered closed.

The staff notes that the applicant appears to have combined the aspects of several GALL programs into its Chemistry Program. By letter dated March 28, 2003, the staff requested, in RAI B.1.4-2, the applicant to clarify to what extent the Chemistry Program relies on the GALL AMPs XI.M20, "Open-Cycle Cooling Water System," and XI.M21, "Closed-Cycle Cooling Water System." In addition, the staff requested a discussion on how the features of these GALL programs are incorporated into the VCSNS Chemistry Program.

In its response dated June 12, 2003, the applicant stated that the Service Water System Reliability and In Service Testing Program, not the Chemistry Program, is credited for meeting the requirements of GALL AMP XI.M20, "Open-Cycle Cooling Water System." The applicant stated that this program meets the intent of GL 89-13, "Service Water System Problems Affecting Safety-Related Equipment." As a response to Recommended Action #2 of GL 89-13, VCSNS evaluated its component cooling water, chemical volume and control, residual heat removal, spent fuel cooling and chilled water systems. The results of the evaluation indicated that the corrosion protection of these systems had not been compromised. This conclusion was based on a review of the historical maintenance work requests from the time of adopting the CHAMPS computer software (to track condition reports and work orders). VCSNS maintains the chemical concentrations of its closed cycle cooling systems within the guidelines of EPRI TR-107396, "Closed Cooling Water Chemistry Guidelines." The applicant stated that, prior to the period of extended operation, one-time inspections will be conducted in low flow areas of various closed, treated water systems to demonstrate the effectiveness of the Chemistry Program.

The applicant's response indicates that the requirements for GALL AMP XI.M20 are credited in the Service Water System Reliability and In-Service Testing Program. Therefore, the components managed by the open-cycle cooling water system, as defined in the GALL report, are discussed and evaluated in Section 3.3.2.3.1 of this SER.   With respect to the GALL program requirements for the closed-cycle cooling water system, the staff finds that the applicant appropriately applied the scoping requirements in the GALL report by treating the aforementioned systems as open-cycle cooing water systems. This action is required in

response to GL 89-13 for which one or more of the following conditions is not satisfied: the system is not subject to significant sources of contamination, the water chemistry is controlled, and the heat is not directly rejected to a heat sink. Thus, the components normally managed by the closed-cycle cooling water system as defined in the GALL report are, for VCSNS, discussed and evaluated in Section 3.3.2.3.1 of this SER. Based on the discussion above, the staff finds that the applicant response satisfactorily addresses the staff concerns and RAI B.1.4-2 is considered closed.

The AMR Tables in the LRA refer to conditions in which CS components in a treated water environment were subject to SCC. By letter dated March 28, 2003, the staff requested, in RAI B.1.4-3, the applicant to clarify which aging management program is credited for the prevention, detection, or mitigation of the effects of SCC in these CS components. The staff notes that according to the ASM Handbook, Vol. 11, “Failure Analysis Prevention,” and EPRI TR-107396, SCC occurs in CS usually in the presence of hydroxides, carbonates or nitrates. In its response dated June 12, 2003, the applicant stated that, although industry data does not exhibit widespread incidence of SCC in low strength CS, there was a reported case suspected to be nitrate-induced SCC of CS in a treated water system. Thus, VCSNS conservatively listed SCC as a possible aging mechanism in certain closed systems (such as the diesel generator, chilled water, air handling, and local ventilation systems) where nitrates are added as a corrosion inhibitor. The VCSNS Chemistry Program maintains nitrates levels within the EPRI TR-107396 guidelines; therefore, the applicant maintained that the Chemistry Program adequately manages SCC of CS components in a treated water environment. Based on the applicant’s application of the EPRI chemistry guidelines and a review of its operating history, the staff finds that the applicant response satisfactorily addresses the staff concerns and RAI B.1.4-3 is considered closed.

The applicant stated that its Chemistry Program is consistent with the ten elements of GALL AMP XI.M30, “Fuel Oil Chemistry”; however, the program does not verify the program’s effectiveness at locations where contaminants may accumulate as recommended in the GALL Report. Thus, by letter dated March 28, 2003, the staff requested, in RAI B.1.4-4, the applicant to discuss the basis for not including the verification of the effectiveness of this program to manage loss of material. In its response dated June 12, 2003, the applicant stated that the details of the sampling of fuel oil, contained in plant procedures, are in accordance with standards listed in the GALL report and thus meet the requirements of the GALL report for sampling at different levels inside the fuel oil tanks. Per Technical Specification (TS) 4.8.1.1.2.i.1, the diesel generator fuel oil storage tanks are drained and cleaned every ten years. The applicant further stated that operating experience at VCSNS for the fuel oil components managed by this program reveals no history of age-related degradation for the internal surfaces. The staff finds that the requirements in the TS and the review of the operating history provide adequate verification of this program’s effectiveness; therefore, the applicant response satisfactorily addresses the staff concerns and RAI B.1.4-4 is considered closed.

The LRA credits the Chemistry Program for managing loss of material due to crevice and pitting corrosion in the pressurizer shell and heads clad with austenitic SS, and SS components internally exposed to chemically-treated borated coolant. However, the staff notes that these components are susceptible to crevice and pitting corrosion due to high levels of oxygen, which may be present in the reactor coolant. By letter dated March 28, 2003, the staff requested, in RAI B.1.4-5, the applicant to discuss how the Chemistry Program will ensure a sufficient level of

hydrogen overpressurization to manage crevice corrosion in the pressurizer internal surfaces. In its response dated June 12, 2003, the applicant stated that the RCS environment, including the primary side of the steam generators, is sampled and analyzed for chloride, fluoride, and dissolved oxygen in accordance with EPRI guidelines. In addition, dissolved oxygen concentrations are not permitted to exceed procedure limits for prolonged periods, and action levels have been established to control these concentrations. The applicant further stated that oxygen is controlled in makeup water as well as in the RCS with hydrogen controlled between 25-50 cc/kg H_2O in the RCS to ensure scavenging of oxygen. The staff finds this response partially acceptable because it is consistent with the water chemistry guidelines presented in EPRI TR-105714, “PWR Primary Water Chemistry Guidelines-Revision 4.” According to these guidelines, the computation of production rates of oxidizing species by radiolysis suggests a dissolved hydrogen concentration of significantly less than 15 cc/kg is sufficient to scavenge the oxidizing species under all operating conditions. Since oxygen can also be added to the coolant from other sources, an excess inventory of hydrogen must be maintained while the reactor is at power. Therefore, the guidelines set a range of 25-50 cc/kg to provide a margin against oxidizing conditions and to facilitate operational control. However, the staff determined that the applicant has not adequately demonstrated, through operating history, that the hydrogen overpressure level is maintained at this level to manage the loss of material due to crevice corrosion under these conditions.

In subsequent correspondence dated September 2, 2003, the applicant stated that the chemistry samples are taken from the RCS letdown. Based on industry and plant specific operating experience, this sample point has been determined to provide a good indication of the liquid chemistry conditions. In addition, the applicant stated that the pressurizer gas space has sufficient concentration of hydrogen gas which ensures oxygen is scavenged and, in turn, ensures that the oxygen concentrations are also maintained very low. Based on this discussion, the staff finds that the applicant has demonstrated that the hydrogen overpressure level is maintained to manage the loss of material through chemistry sampling which ensures that the level is within the recommendations of the EPRI guidelines and is supported by plant specific operating experience.

The staff reviewed the criteria 2 supplemental information in Section B.1.4, "Chemistry Program," in which the applicant credited the Chemistry Program to manage the relevant conditions for onset and propagation of the same aging effects in the mechanical system portions that meet the refined 10 CFR 54.4(a)(2) criteria and have similar materials of construction and environment. As a result, the applicant provided clarifications to the program scope, and monitoring and trending elements for this AMP.

[Program Scope] The applicant stated that the boundaries of many systems were expanded to include newly identified piping. In addition, the demineralized water system (DW) was added to the scope of this AMP. The staff finds that the increased scope of this AMP is appropriate and acceptable in managing the identified components that meet 10 CFR 54.4(a)(2).

[Monitoring and Trending] The applicant stated that the DW provides treated water to various plant locations and supplies the nuclear services (DN) portion in the auxiliary and reactor buildings. The DW system treats filtered water for use as the source for the treated and borated water systems and is continuously monitored for effluent conductivity. The demineralized water storage tank (DWST) is sampled for chlorides, sulfate, sodium, silica, magnesium, calcium, aluminum, potassium, total suspended solids (TSS), pH, and total organic

carbon (TOC). The staff finds the increased activities to monitor and trend the constituents of this system adequate and appropriate for mitigating the aging effects through maintenance of water quality. The staff's evaluation of the AMP is found in Section 3.0.3.2 of this SER.

Section 18.2.10 of Appendix A to the LRA contains the applicant's FSAR supplement for the Chemistry Program at VCSNS. The staff reviewed this section and finds that the information provided in the FSAR supplement for the aging management of systems and components discussed above is equivalent to the information in the GALL report, and therefore, provides an adequate summary of the program activities as required by 10 CFR 54.21. Although the applicant noted that the Chemistry Program is based on EPRI guidelines for primary and secondary water chemistry, the staff requested in RAI B.1.4-2 that the FSAR supplement reference the specific EPRI documents that are consistent with the SRP-LR. By letter dated September 2, 2003, the applicant revised the FSAR supplement to include the primary and secondary water chemistry guidelines (i.e., EPRI TR-1057and EPRI TR-102134). Based on this revision, the staff finds that the FSAR supplement provides an adequate summary of the program activities are required by 10 CFR 54.21(d).

3.0.3.2.3 Conclusions

On the basis of its review and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. In addition, the staff has reviewed the exceptions to the GALL program and finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.3 Fire Protection Program

The applicant described its Fire Protection Program (FPP) in Section B.1.5 of Appendix B to the LRA, "Fire Protection Program." The applicant credits this program with managing the aging of FP system components that are within the scope of license renewal and subject to an AMR. The staff reviewed LRA Section 3 and Section B.1.5 to determine whether the applicant has demonstrated that the program will adequately manage the applicable effects of aging during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The applicant's AMR identifies one or more AMPs to be used to demonstrate that the effects of aging will be managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation. The programs to be used for managing the effects of aging were compared to those listed in NUREG-1801, and were evaluated for consistency with NUREG-1801 programs that are relied on for nuclear power plant license renewal. The results are documented and discussed in LRA Section 3, Tables 3.3-1 and 3.3-2, using the format suggested by NUREG-1800, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants".

3.0.3.3.1 Summary of Technical Information in the Application

Section B.1.5 of Appendix B to the LRA states that the FPP is consistent with XI.M26, "Fire Protection," and XI.M27, "Fire Water System," as well as XI.M23, "Selective Leaching of Materials," as identified in NUREG-1801 with the following enhancements that will be made to the current plant program. The applicant's fire door inspections monitor holes or breaks in the door surface at a frequency of every 6 months rather than the recommended bimonthly frequency. Aging management of the fuel supply line for the diesel-driven fire pump at the plant is credited to the chemistry program and is not managed by the FPP. The applicant maintains proper clearances (gap) between doors, frame, and threshold in accordance with station procedures. However, the applicant does not consider maintaining the clearances to be an aging effect for license renewal. The applicant intends to perform ultrasonic testing of selected FP piping to detect aging effects in lieu of disassembly of FP piping for inspection or full-flow testing of stagnant portions of FP piping.

For operating experience, LRA Section B.1.5 states that the fire barrier and fire barrier penetration seal inspection in the past five years do not indicate any fire barrier or fire barrier penetration seal that is in non-conformance with the acceptance criteria. Non-conforming conditions that were aging related cracks and separations were noted during surveillance of fire barrier penetration seals. Conditions were repaired in accordance with station procedures. No condition evaluations reports (CERs) were initiated for fire barriers of fire barriers penetrations seals relevant to aging. Furthermore, LRA Table 3.3-1, Item 19, for the commodity groups of doors and barrier penetration seals and concrete structures in fire protection, provides the following discussions for the AMP:

> The plant's aging management programs for this group are generally consistent with those reviewed and approved in NUREG-1801. The plant's fire protection program (Appendix B.1.5) contains many activities to achieve defense-in-depth and minimize the impact of a potential fire.
>
> The fire barrier and fire barrier seal inspections detect structural damage or degradation of fire barriers and fire barrier penetration sealing devices. Fire barriers include walls, ceilings and floors. The corresponding aging effects are cracking, separation from walls or components, separation of material layers, rupture or puncture of seals, shrinkage and voids.
>
> The fire door inspections detect structural damage or degradation of fire rated doors. Inspections are credited with managing loss of material of doors and door hardware for the period of extended operation. Excessive wear for door appurtenances such as latches, strike plates, hinges, sills and closing devices, and maintaining proper clearances (gaps) between the door, frame and threshold are also inspected, but these attributes are not credited for license renewal. Loss of material due to wear of the door hardware and hinges is not considered an aging effect but rather a consequence of frequent or rough usage.

According to LRA Section B.1.5, the plant has no failures or adverse trends for fire doors. Surveillance inspections in the last five years have not identified any non-conformance relative to the acceptance criteria. No non-conformance notices (NCNs) or CERs were initiated for fire doors relevant to aging.

The LRA states that monthly surveillance are conducted on the FP system consisting of flow tests and pump start tests. Flow tests and flushes of the main distribution loops have been conducted to ensure their functionality and have all met acceptance criteria. Working pressure and flow pressure are measured during these tests. This will indicate fouling to an unacceptable level and hence manage this aging effect. Fire hydrants and sprinklers are visually inspected for aging effects. This visual inspection looks for painted, corroded, damaged, or dirty sprinkler heads, obstruction of sprinkler heads, and proper orientation of

sprinkler heads. The fire hydrants are inspected for corrosion on the exterior surfaces that might impede operation and standing water in the hydrant barrel that might indicate valve leakage or fouling.

A NCN was generated in January of 1994 in association with low flow during flow testing of the main distribution loop. As part of the resolution the piping was hydrolyzed to remove the accumulated deposits. Additionally, engineering evaluation determined that a reduction and redistribution of sprinkler heads was permissible and would restore the required pressure at the sprinkler heads to ensure full spray pattern. The results of flow testing of the FP piping since this occurrence have been found acceptable.

On the basis of the information discussed above, the applicant concluded that the FPP has been demonstrated to be effectively detecting and managing aging effects for the fire water system, the fire barriers and fire barriers penetrations seals, and for fire doors. The FPP provides reasonable assurance that the aging effects will be managed such that the components subject to an AMR will continue to perform their intended functions consistent with the CLB for the period of extended operation.

3.0.3.3.2 Staff Evaluation

The staff reviewed LRA Section 3.3.1 and Section B.1.5 of Appendix B to the LRA and LRA Table 3.3-1, Item 19 to determine whether the applicant had demonstrated that the effects of aging for the FP system will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff's review was conducted in accordance with Section 3.3 of the SRP-LR (NUREG-1800) and is described below.

In Section B.1.5 of Appendix B to the LRA, the applicant describes its AMP to manage the aging of structures and components in the FP system. The LRA states that this AMP is consistent with NUREG-1801 programs in Chapters XI.M26, "Fire Protection," and XI.M27, "Fire Water System."

The NUREG-1801 programs in Chapter XI.M26 include a fire barrier inspection program and a diesel-driven fire pump inspection program. The fire barrier inspection program requires periodic visual inspection of fire barrier protection seals, fire barrier walls, ceilings, and floors, and periodic visual inspection and functional tests of fire-rated doors to ensure that their operability is maintained. The diesel-driven fire pump inspection program requires that the pump be periodically tested to ensure that the fuel supply line can perform its intended function. The AMP also includes periodic inspection and testing of the halon/carbon dioxide fire suppression system.

The NUREG-1801 programs in Chapter XI.M27 apply to water-based FP systems that consist of sprinklers, nozzles, fittings, valves, hydrants, hose stations, stand pipes, water storage tanks, and aboveground and underground piping and components that are tested in accordance with the applicable codes and standards of the National Fire Protection Association (NFPA). Such testing assures the minimum functionality of the systems. Also, these systems are normally maintained at the required operating pressure and are monitored such that loss of system pressure is immediately detected and corrective actions will be initiated. In addition to the NFPA codes and standards, those portions of the FP sprinkler system that do not currently contain programs to manage aging and are not routinely subjected to flow are to be subjected

to full flow tests at the maximum design flow and pressure before the period of extended operation (and at not more than 5-year intervals thereafter). In addition, a sample of the sprinkler heads is to be inspected by using the guidance of NFPA 25, "Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems." Section 2.3.3.1 of NFPA 25 states that "where sprinklers have been in place for 50 years, they shall be replaced or representative samples from one or more sample areas shall be submitted to a recognized testing laboratory for field service testing." It also contains guidance to perform this sampling every 10 years after the initial field service testing. Finally, portions of the FP suppression piping located above ground and exposed to water are disassembled and visually inspected internally once every refueling outage. The purpose of full-flow testing and internal visual inspections is to ensure that corrosion, microbiologically induced corrosion (MIC), or biofouling aging effects are managed such that the system function is maintained.

LRA Section 3 identifies those components for which the FPP is identified as an AMP. The staff reviewed and verified that the components in LRA Section 3 to which the program applies are consistent with the intent of NUREG-1801 programs as described in Chapters X1.M.26 and X1.M.27. The staff finds this acceptable.

The staff also reviewed the enhancements to the applicant's AMP that are identified in the LRA and requested the applicant to provide additional information to address the staff's concerns. In a letter dated March 28, 2003, in RAI B.1.5-1 (1), the staff asked the applicant to confirm that the guidance which will be added to the diesel fuel pump maintenance procedure will ensure that the diesel-driven fire pump is under observation for detecting any degradation of the fuel supply line during the performance tests (e.g., flow and discharge tests, sequential starting capability tests, and controller function tests). In its June 12, 2003, response, the applicant stated that, in present monthly surveillance test procedure for the diesel fire pump, a visual inspection of any leaks or abnormalities of the pump is required and any degradation to the diesel fire pump fuel oil line would be detected and documented during this pre-starting visual inspection. The staff finds the applicant's response acceptable, because it is consistent with the GALL report. GALL requires the performance test to be at least once every refueling outage.

In a letter dated March 28, 2003, in RAI B.2.5-1 (2), the staff asked the applicant to confirm that (1) the guidance which will be added to the CO_2 fire suppression system and the fire damper inspection procedures will include periodic visual inspection to examine signs of degradation, (2) the material conditions that may affect the performance of the system, such as corrosion, mechanical damage, or damaged dampers, will be observed during inspection, and (3) the inspection will be performed at least once every month to verify that the extinguishing agent supply valves are open, and the system is in an automatic mode.

By letter dated June 12, 2003, the applicant provided the following response:

> The present surveillance test procedures for fire dampers require visual inspections of fire dampers that specifically look for changes in appearance or abnormal degradations. These surveillance test procedures are performed every 18 months. No aging effects have been identified for the internal surfaces for CO_2 suppression system components. Aging of the external surfaces for the components will be managed by the Inspections for Mechanical Components program. At the plant, the CO_2 fire suppression system valve lineup is required by the FP program to be performed every 92 days. The interval for the carbon dioxide fire suppression system valve lineup was changed from monthly to quarterly under the provisions of 10CFR50.59.

The applicant takes exception to the GALL with regard to the inspection frequency of fire dampers and testing for CO_2 fire suppression system. GALL specifies semi-annual inspection, whereas, the plant performs testing every eighteen months under the CLB. The applicant clarified its position that no aging effects have been identified for internal surfaces for CO_2 suppression components. Aging of external surfaces for the components will be managed by the inspection for mechanical components. Based on the operating experience provided by the applicant and explanation of managing aging effects on fire dampers and CO_2 fire suppression system, the staff finds this extended inspection duration acceptable.

In a letter dated March 28, 2003, in RAI B.1.5-1 (3), the staff asked the applicant to confirm that (1) the specific guidance which will be added related to the fire door inspections will ensure the hollow metal fire doors to be visually inspected at least once bi-monthly for holes in the skin of the door, (2) fire door clearances are also checked at least once bi-monthly as part of an inspection program, and (3) the function tests of the fire doors are performed daily, weekly, or monthly (which may be plant-specific) to verify the operability of automatic hold-open, release, closing mechanisms, and latches.

By letter dated June 12, 2003, the applicant provided the following response:

> Current plant surveillance test procedures are performed on fire doors on a minimum frequency of six months. These procedures require visual inspections of the following: (a) automatic closing mechanisms – to verify no oil leaks, hardware fasteners are secure, and adjusting rods are in place and secure; and (b) door integrity – to verify latches are securely in place, free movement of bolts, bolt engages door strike, knobs and surface hardware are firmly attached, door closes and latches on its own power, no holes or breaks in the door skin, and no broken, damaged or cracked door glass.
>
> As noted in LRA Section B.1.5, the plant's fire rated doors are inspected (as specified above) at a frequency of every 6 months under the current licensing basis rather than the bi-monthly frequency recommended in NUREG-1801, Section XI.M26. Based on the plant and industry operating experiences, the 6 month inspection frequency provides reasonable assurance that degradation of a door is detected prior to loss of function.

The applicant takes exception to GALL with regard to the frequency of the aging inspection of the fire doors. GALL specifies bi-monthly inspections, whereas the plant performs inspections semi-annually under the CLB. The applicant states that surveillance inspections in the last five years did not identify any non-conformance relative to the acceptance criteria and no NCNs and CERs were initiated for fire doors relevant to aging. Furthermore, LRA Section B.1.5 states that the fire doors inspections detect structural damage or degradation and inspection are credited with managing loss of material of door and door hardware for the period of extended operation. The applicant further stated that the excessive wear for doors appurtenances such as latches, strike plates, hinges, sill and closing devices, and maintaining proper clearances (gaps) between the door, frame and threshold are also inspected, but these attributes are not credited for license renewal. Based on the operating experience provided by the applicant and the explanation of managing aging effects of fire doors, the staff finds this extended inspection duration acceptable.

The staff has proposed a revision to NUREG-1801 program in Chapter XI.M27 related to inspections for wall thinning of piping due to corrosion. The revised staff position states that each time the system is opened, oxygen is introduced into the system, thus accelerating the potential for general corrosion. Therefore, the staff has recommended that a non-intrusive means of measuring wall thickness, such as ultrasonic inspection, be used to detect this aging effect. The staff recommends that, in addition to a baseline ultrasonic inspection of the fire

protection piping that is performed before exceeding the current licensing term, the applicant perform ultrasonic inspections at 10-year intervals thereafter. In a letter dated March 28, 2003, in RAI B.1.5-1(4), the staff asked the applicant whether the inspection criteria for the FP SSCs conforms with the staff position in interim staff guidance (ISG)-04 (ADAMS Accession ML022260137, dated December 12, 2002).

By letter dated June 12, 2003, the applicant provided the following response:

> Section B.1.5 of the LRA lists the wall thickness evaluations as an enhancement to the FP program. The plant will perform the wall-thickness evaluations of above ground fire protection piping prior to the end of the current operating term (i.e., August 6, 2022). Subsequent evaluations will occur at 10-year intervals thereafter. At the plant, the internal surfaces of underground piping for fire service is cement lined. No aging effects have been identified for the internal surfaces of cement lined piping in a raw water environment.
>
> Section B.1.5 of the LRA lists the sprinkler testing/replacement as an enhancement to the FP program. Testing/replacement will be performed in accordance with NFPA Code 25, which states that this should be done prior to year 50 of sprinkler system life, with subsequent testing performed at 10-year intervals. To ensure testing is performed prior to year 50 of sprinkler system life, the plant will perform this testing prior to the end of the current operating term (August 6, 2022).

The staff has reviewed the above discussion to determine whether the AMP is adequate to manage the aging effects for which it is credited. The staff finds that this AMP conforms with the staff position in ISG-04 and, therefore, applicant's response to RAI B.1.5-1(4), is acceptable.

By the letter dated March 28, 2003, in RAI B.1.5-2, the staff informed the applicant about its concern that the applicant's FPP may not adequately manage aging of coatings in steel structures, since neither XI.M26 nor XI.M27 address coatings. On this basis, the staff asked the applicant to identify any steel structures within the scope of license renewal and subject to an AMR which depend on coatings to protect the steel structures from age-related degradation, and describe the AMP and activities that manage the aging effects for the coatings.

In its June 12, 2003, letter, the applicant provided the following response:

> The plant's Fire Protection Program (as described in Application Section B.1.5) is focused primarily on the fire protection system components, fire barriers and seals, and fire doors (consistent with GALL Sections XI.M26 and XI.M27). Steel structures (including structural steel components) within the scope of license renewal are identified by building in LRA Section 2.4 and TR00170-003. Additionally, all structural steel has a protective coating which provides protection against age-related degradation. As noted in LRA Table 3.5-1 (in Item 16), aging of steel components is managed by the Maintenance Rule Structures Program as described in LRA Section B.1.18. This program inspects structural steel for integrity via visual inspections of coatings for degradation, such as peeling, flaking, blistering, rusting , scaling, etc. For containment steel structures (liner), the AMPs described in LRA Sections B.1.11, B.1.15 and B.1.16 also apply.

The staff finds the applicant's response acceptable because it addressed the concern.

3.0.3.3.3 Conclusion

On the basis of its review and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, the applicant has demonstrated that the effects of aging will be adequately managed so that the

intended functions will be maintained consistent with the CLB for the period of extended operation as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.4 Maintenance Rule Structures Program

The applicant described its Maintenance Rule Structures Program in Section B.1.18 of Appendix B to the LRA. The applicant credits this program with the capability of detecting and managing the effects of aging for structures and structural components at VCSNS. The staff reviewed the LRA to determine whether the applicant has demonstrated that the Maintenance Rule Structures Program will adequately manage the applicable aging effects for the components that credit this program throughout the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.0.3.4.1 Summary of Technical Information in the Application

In LRA Section B.1.18, the applicant states that the Maintenance Rule Structures Program is consistent with XI.S6, Structures Monitoring Program, as identified in NUREG-1801. The applicant further states that the following enhancements will be incorporated into the Maintenance Rule Structures Program prior to the period of extended operation:

Future inspections will add:

- north berm
- electrical manhole
- EMH-2 interior inspection
- inaccessible areas when exposed by excavation
- flood barrier seals for control and diesel generator buildings
- portions of the power path from the power circuit breaker (PCB) in the substation to the safety related buses
- groundwater chemical analyses

Groundwater chemical analyses will include:

- ph
- Sulfates
- Chlorides

Groundwater chemical analyses will be used to monitor changes in aggressiveness of the below grade environment.

The Maintenance Rule Structures Program is included in the discussion column of LRA Table 3.5-1. The structures and structural components that credit this program for license renewal are identified in Report TR00170-003, Rev 0, Attachment II.

In 1996, a baseline assessment concluded that the maintenance rule structures and structural components were acceptable and were free of deficiencies or degradation that could lead to

possible failure. Therefore, these structures were determined to be capable of performing their structural functions, including the protection and support of systems and components.

The maintenance rule inspection report completed in 2000 noted that most of the maintenance rule structures and structural components were evaluated to be “Acceptable” with regards to continued function. However, nine items/areas were identified as “Acceptable with Deficiencies” that exhibited a trend of aging. These conditions mostly deal with rust/corrosion due to weathering, water in-leakage and ponding. The applicant determined that none of the conditions have an immediate adverse effect on the ability of the structures or components to perform their intended function(s). These items were entered into the plant corrective action program for resolution. The next inspection is scheduled in 2005.

The applicant states that the Maintenance Rule Structures Program provides reasonable assurance that the aging effects for structures and structural components will be managed such that the components subject to aging management review will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

3.0.3.4.2 Staff Evaluation

In LRA Section B.1.18, “Maintenance Rule Structures Program,” the applicant described its AMP to manage aging in structures and structural components. The LRA stated that this AMP is consistent with GALL AMP XI.S6, “Structures Monitoring Program,” with several enhancements described in SER Section 3.0.3.4.1. The staff reviewed the enhancements to determine whether the AMP, with the enhancements, remains adequate to manage the aging effects for which it is credited, and reviewed the FSAR supplement to determine whether it provides an adequate description of the revised program. The staff audit on July, 16-17, 2003 confirmed the applicant’s claim of consistency.

The staff noted several inconsistencies between the FSAR Supplement summary descriptions of the aging management programs in LRA Appendix A and the scope of the aging management programs identified in LRA Appendix B as “consistent with GALL.” In RAI 3.5-19, the staff requested the applicant to verify that the complete scope of the aging management program, as described in NUREG-1801, GALL Volume 2, is being credited for license renewal aging management. If this is not the case, the applicant was requested to identify and document the justification for each exception. In response to RAI 3.5-19, the applicant stated the following:

> As stated in the LRA, VCSNS maintains a Maintenance Rule Structures Program (B.1.18), which is consistent with GALL XI.S6 and 10 CFR 50.65. Several enhancements to this program have been identified during the license renewal evaluation process and are listed in the Application (B.1.18).
>
> VCSNS does not believe that there are any further changes required for the Application Appendix A, since only summary statements are recommended by NEI 95-10. Commitment to all Regulations and Regulatory Guides are implicit in the development of each of these programs as described in Section 7 of TR00170-003.

LRA Section B.1.18 states that the Maintenance Rule Structures Program is consistent with GALL XI.S6 with several listed enhancements that will be incorporated into the program prior to

the period of extended operation. In RAI 3.5-23, the staff requested that the applicant provide the following information regarding this program:

(a) Verify that the scope of this program includes visual inspection of concrete for aging effects of loss of material, cracking and change in material properties and explain what this program requires for VCSNS concrete structures.

(b) Since the North Berm, an earthen embankment, will be incorporated into the scope of this program, clarify that this program is also completely consistent with all the attributes of GALL XI.S7 and RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants.

(c) Since this program is credited for managing aging effects of masonry walls, clarify that this program is also completely consistent with all the attributes of GALL XI.S5, Masonry Wall Program.

(d) Clarify the apparent editorial mistake in the last sentence of the second paragraph of LRA Section B.1.18.1 that states: "…including the protection and support of 0 systems and components."

(e) The commitment to incorporate the enhancements to this program discussed in LRA Section B.1.18 should also be included in the FSAR Supplement, Appendix A, Section 18.2.22. This section does not currently include such a commitment. Issues related to the FSAR supplement are being addressed by the staff on a generic basis.

In response to RAI 3.5-23, the applicant stated the following:

> The Maintenance Rule Structures Program (B.1.18) includes visual inspection of concrete for all aging effects including loss of material, cracking, and change in material properties. This program requires walkdowns of all Important to Maintenance Rule Structures at VCSNS. Walkdowns are conducted by qualified engineering (structural) personnel. Plant procedures and guidelines (as described in Section 7.12 of TR00170-003) define inspection details and criteria for identifying aging mechanisms and effects.
>
> (a) Inspection of the North Berm will be performed under plant engineering services procedures, consistent with the inspections required under the Service Water Pond Dam Inspection Program (RG 1.127), which is consistent with the attributes of GALL XI.S7.
>
> (b) By plant design, there are no masonry walls located within safety related structures; therefore, VCSNS had no actions associated with IEB 80-11 and IN 87-67. However, masonry walls in non-safety related structures are inspected under the Maintenance Rule Structures Program, consistent with the attributes of GALL XI.S5. [Also see response to RAI 2.4.1-4.]
>
> (c) The sentence in Application Section B.1.18.1 should read: "…including the protection and support of safety-related systems and components."
>
> (d) Consistent with NEI 95-10, VCSNS does not see the need to include these minor enhancements into the very generic summary description of the Maintenance Rule Structures Program (Application Appendix A Section 18.2.22).

The staff finds the applicant's responses to RAI 3.5-23 Parts (a) thru (c) to be acceptable since they confirm the consistency of the program with the GALL Report.

3.0.3.4.3 Conclusion

On the basis of its review and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.5 Above Ground Tank Inspection Program

The Above Ground Tank Inspection Program is a new one-time inspection program described in Section B.2.1 of Appendix B in the LRA. The LRA credits the Above Ground Tank Inspection Program with detecting and characterizing loss of material due to galvanic and general corrosion in an internal air space environment, and loss of material and cracking due to the corrosive effects of alternate wetting and drying in treated or borated water environments. The staff reviewed the LRA to determine whether the applicant has demonstrated that the inspection will adequately verify the effectiveness of an aging management program and confirm the absence of an aging effect prior to the period of extended operation as required by 10 CFR 54.21 (a) (3).

3.0.3.5.1 Summary of Technical Information in the Application

The applicant's Above Ground Tank Inspection Program is discussed in LRA Section B.2.1, "Above Ground Tank Inspection Program." The applicant states that this program is a new one-time inspection activity that will be consistent with GALL AMP XI.M32, "One-Time Inspection," and will be performed prior to the period of extended operation. This inspection will determine if aging management is required for the internal surfaces of certain tanks and associated components (including pipe and valves) during the period of extended operation, as described in the FSAR supplement (Section 18.2.3 of Appendix A to the LRA). In addition, the applicant states that implementation of the Above Ground Tank Inspection Program will either verify that there are no aging effects requiring management for the subject components or appropriate corrective actions will be taken so that the component intended functions will be ensured for the period of extended operations.

The LRA states that this program will detect and characterize loss of material due to galvanic and general corrosion in locations with exposure to moist air conditions, loss of material due to general corrosion in locations with exposure to treated water in which dissolved oxygen levels are not controlled, and loss of material and/or cracking due to the corrosive effects of alternate wetting and drying of treated or borated water. The Above Ground Tank Inspection will use suitable examination techniques at the most susceptible (sample) locations.

The internal surfaces of the following components will be inspected by this one-time inspection:

- carbon steel tanks exposed to an internal air space environment in the condensate, component cooling, and chilled water systems;

- carbon steel pipe and valves exposed to an internal air space environment in the component cooling system;

- carbon steel and stainless steel tanks exposed to a treated water environment in the condensate, component cooling, reactor makeup water supply and chilled water systems;

- carbon steel tanks, pipe and valves exposed to treated water having uncontrolled oxygen levels in the sodium hydroxide storage tank in the reactor building spray system; and

- stainless steel tanks exposed to a borated water environment in the refueling water system (refueling water storage tank).

3.0.3.5.2 Staff Evaluation

In LRA Section B.2.1, “Above Ground Tanks Inspection Program,” the applicant described its AMP to manage the internal surfaces of certain tanks and associated components (including pipe and valves). The LRA stated that this AMP is a new one-time inspection activity that will be consistent with GALL AMP XI.M32, “One-Time Inspection,” and will be performed prior to the period of extended operation.

The staff reviewed this program using the guidance in Branch Technical Position RLSB-1 in Appendix A of the SRP-LR and focused on how the program manages aging effects through the effective incorporation of 10 elements (i.e., program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience.) The applicant indicated that the corrective actions, confirmation process, and administrative controls are part of the site-controlled Quality Assurance Program. The staff’s evaluation of the Quality Assurance Program is provided separately in Section 3.0.4 of this SER. The remaining seven elements are discussed below.

[Program Scope] The staff finds that the systems and components to be monitored by the program, as listed in the LRA, are within the scope of license renewal as identified in Section 2.3 of the LRA. In addition, the scope of the program is acceptable, since it includes the appropriate components within the scope of license renewal to be inspected for susceptibility to loss of material due to galvanic and general corrosion and/or cracking.

[Preventive Actions] There will be no preventive or mitigative actions taken as part of this program, and the staff did not identify the need for such actions. The staff notes that the one-time inspection is an inspection activity independent of methods to mitigate or prevent degradation.

[Parameters Monitored or Inspected] The program will examine the metal tanks and associated piping components in the condensate, component cooling, and chilled water systems; component cooling system; reactor building spray system; and refueling water system for wall thickness and visible evidence of corrosion, cracking or other age-related degradation. The staff finds these parameters acceptable because they are directly related to the degradation of metal tanks and associated piping components in the aforementioned systems.

[Detection of Aging Effects] The aging effects that will be detected and characterized by this program are identified by proven visual and/or volumetric inspection techniques on a sampling

of the subject components to be determined by engineering evaluation. The applicant stated that the results of the inspection will be applied to the remainder of the components within the scope of the inspection activity. In addition, for components exposed to borated and treated water environments, the sample population should include locations near the air-water interface within the stainless steel refueling water storage tank (RWST), and near the air-water interface within one of the following carbon steel tanks: the condensate storage tank, the component cooling surge tank, or one of the chilled water expansion tanks. An engineering evaluation is expected to confirm that the borated water environment of the RWST is more likely to concentrate contaminants at the air-water interface than the treated water environment of the reactor makeup water supply tank. For components exposed to treated water with uncontrolled oxygen levels, the sample population should include the submerged portions of the sodium hydroxide tank and that for components exposed to an internal air space environment, the sample population should include locations within the air space of one of the following carbon steel tanks: the condensate storage tank, the component cooling surge tank, or one of the chilled water expansion tanks. If possible, to simplify the inspection, the same tank chosen to inspect for corrosive impacts of alternate wetting and drying should be selected for this inspection.

The staff finds that these inspection techniques are sufficient to provide reasonable assurance that the aging effects for the components addressed by the Above Ground Tank Inspection will be detected and evaluated before there is a component loss of intended function. Based on the plant specific and industry operating experience, the use of one-time inspection is appropriate for inspections where degradation is possible, but is not expected. This one-time inspection provides for additional inspections should the corrective action process require additional information to characterize the aging effects.

[Monitoring and Trending] The LRA states that no actions will be taken as a part of the Above Ground Tank Inspection to trend inspection results. This is a one-time program used to determine if further actions are required. The staff notes that the evaluation of the techniques and the timing of the one-time inspection improve as plant-specific and industry-wide experience increases. By letter dated March 28, 2002, the staff requested, in RAI B.2.1-1, that the applicant address any changes made in the monitoring and trending of components exposed to borated water as a result of the boric acid-induced corrosion of the Davis-Besse vessel. In its response dated June 12, 2003, the applicant stated that both site-specific and industry-wide operating experience was researched and is contained within the body of technical work at VCSNS supporting the LRA. The applicant further stated that, since the aim of the one-time inspection is to determine if further actions are required, there will be no action to trend the inspection results. In addition, this one-time inspection is being developed because it was determined that the aging effects were possible and not because these aging effects were found at VCSNS. The staff finds the applicant response satisfactory since the applicant has taken into account site-specific and industry-wide operating experience. In addition, this inspection program will determine the extent to which the degradation is applicable at VCSNS. The staff notes that should the inspection results indicate that further inspections are needed, the program's corrective actions will be employed. Therefore, RAI B.2.1-1 is considered closed.

[Acceptance Criteria] The LRA states that the acceptance criteria for this program will be no unacceptable loss of material or cracking of subject components that could result in a loss of the component intended function(s) as determined by engineering evaluation. The staff considers this engineering evaluation to be adequate to ensure that the component intended

function(s) are maintained under all CLB design conditions during the period of extended operation.

[Operating Experience] The LRA states that the Above Ground Tank Inspection is a new one-time inspection for which no operating experience exists. The staff finds that the inspection proposed by the applicant will either verify that there are no aging effects requiring management for the subject structures and components, or identify where appropriate corrective actions need to be taken during the period of extended operation.

The staff notes that the GALL AMP XI.M29, “Above Ground Carbon Steel Tanks,” defines preventive measures to mitigate corrosion by protecting the external surface of carbon steel tanks with paint or coatings in accordance with standard industry practice. This GALL AMP is not credited for aging management in the VCSNS LRA. The staff also notes that Section B.1.15, “Containment Coating Monitoring and Maintenance Program,” of the LRA, discusses an existing AMP that manages the loss of material due to coating degradation. However, this AMP is not credited with managing the external surfaces of the tanks. By letter dated March 28, 2003, the staff requested, in RAI B.2.1-2, the applicant to explain how the Above Ground Tank Inspection Program adequately manages the external surface of the above ground tanks if this program only inspects the internal surfaces of the tanks.

In its response dated June 12, 2003, the applicant stated that the Above Ground Tank Inspection is not the same as the GALL AMP XI.M29, “Above Ground Carbon Steel Tanks.” In addition, tank foundations and supports are inspected under the Maintenance Rule Structures Program (Section B.1.18 of Appendix B to the LRA). Outside above ground steel tanks (condensate storage tank, refueling water storage tank, reactor make-up water storage tank, and sodium hydroxide storage tank) are externally inspected under the Maintenance Rule Structures Program and include visual inspections of the exterior surface of the tank, anchor bolts and attachment anchorage plates/welds, concrete foundation support pads, piping connections, and caulking between tank /foundation. Based on the applicant’s response and the staff evaluation of the Maintenance Rule Structures Program in Section 3.0.3.4 of this SER, the staff finds that the external surfaces of the tanks will be adequately managed for external degradation. Therefore, RAI B.2.1-2 is considered closed.

The LRA states that the Above Ground Tank Inspection Program will be consistent with the GALL AMP XI.M32, “One-Time Inspection.” The staff compared this program with the one-time inspection program defined in GALL report. As a result, by letter dated March 28, 2003, the staff requested, in RAI B.2.1-3, the applicant to discuss the qualifications of the personnel conducting the inspection and the design minimum wall thickness and criteria for verifying the absence of cracking.

In its response dated June 12, 2003, the applicant stated that inspections required by this program would be performed by personnel qualified in accordance with the ASME Boiler and Pressure Vessel Code and 10 CFR 50 Appendix B. In accordance with the ASME code, the minimum wall thickness will be determined by the design of the individual component and the cracking will be detected by volumetric and visual inspections. The staff finds the applicant’s response satisfactory because qualified personnel will perform the appropriate inspection techniques in accordance with the ASME code and 10 CFR 50 Appendix B. Therefore, RAI B.2.1-3 is considered closed.

In summary, based on this review, the staff concluded that the Above Ground Tank Inspection is consistent with the requirements of the 10 elements of Branch Technical Position RLSB-1 in Appendix A of the SRP-LR. The staff confirmed the applicant's claim of consistency during the AMR Audit on July 16 - 17, 2003. The staff verified that this program, as described, is consistent with GALL AMP XI.M32.

Section 18.2.3 of Appendix A to the LRA contains the applicant's FSAR supplement for the Above Ground Tank Inspection at VCSNS. The staff reviewed the FSAR supplement and finds that the description of the Above Ground Tank Inspection is consistent with Section B.2.1 of the LRA. Therefore, the staff finds that the information provided in the FSAR supplement provides an adequate summary of the program activities as required by 10 CFR 54.21(d).

3.0.3.5.3 Conclusions

On the basis of its review and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.6 Buried Piping and Tanks Inspection Program

The Buried Piping and Tanks Inspection Program is described in Section B.2.10 of Appendix B in the LRA. The LRA credits this AMP with managing loss of material on the external surfaces of buried carbon steel, cast iron, and ductile iron components exposed to an underground environment in the diesel generator services, emergency feedwater, fire service, and service water systems at the VCSNS. The staff reviewed the LRA to determine whether the applicant has demonstrated that the Buried Piping and Tanks Inspection Program will adequately manage the applicable aging effect (loss of material) for the components that credit this program during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.0.3.6.1 Summary of Technical Information in the Application

The applicant's Buried Piping and Tanks Inspection Program is described in LRA Section B.2.10, "Buried Piping and Tanks Inspection Program." The applicant states that this is a new inspection activity and therefore summarizes the program in terms of the 10 element program as described in Branch Technical Position RLSB-1 in Appendix A-1 of the SRP-LR. In addition, this program will be consistent with GALL AMP XI.M34, "Buried Piping and Tanks Inspection," and will be performed prior to the period of extended operation.

The LRA credits this inspection activity to manage loss of material due to crevice, galvanic, general, pitting, and microbiologically influenced corrosion (MIC) on the external surfaces of components exposed to an underground environment. In addition, the program will have elements of a condition-monitoring program and a prevention program. The conditions of coatings and wrappings will be determined by visual inspection whenever buried components are excavated, such as for maintenance. Degraded coatings or wrappings are indicative of

potential surface corrosion of the external piping or tank surfaces and will require further evaluation as discussed in the FSAR supplement (Section 18.2.9 of Appendix A to the LRA).

Within the auxiliary system, the following major components and systems will be monitored by this aging management program: carbon steel (CS) pipes and couplings in the service water system; ductile iron pipe and cast iron hydrants and valve bodies the in fire service system; CS pipes in the emergency feedwater system; and CS fuel oil pipes, fittings, and tanks in the diesel generator service systems. Within the steam and power conversion systems, this inspection program will also monitor orifices in the emergency feedwater system.

3.0.3.6.2 Staff Evaluation

In LRA Section B.2.10, “Buried Piping and Tanks Inspection Program,” the applicant described its AMP to manage the loss of material of buried components. The staff’s evaluation of the Buried Piping and Tanks Inspection focuses on how the program detects and characterizes aging effects through the effective incorporation of the ten elements described in Branch Technical Position RLSB-1 in Appendix A-1 of the SRP-LR.

Since the applicant claimed consistency with GALL AMP XI.M34, this AMP was cross-referenced in the staff’s review. The 10 program elements in this GALL AMP define programmatic characteristics and criteria to manage buried components except for the program elements/attributes of detection of aging effects (regarding inspection frequency) and operating experience. Thus, the staff further evaluates an applicant’s inspection frequency and operating experience with buried components. The LRA indicates that the corrective actions and confirmation process are implemented through the site corrective actions process, while the administrative controls are implemented through the site procedures. The staff’s evaluation of the corrective actions, confirmation process, and administrative controls is contained in Section 3.0.4, “Quality Assurance Program,” of this SER. The remaining elements are evaluated below.

[Program Scope] The staff finds that the systems and components that will be monitored by this program, as listed in the LRA, are within the scope of license renewal and identified in Section 2.3 of the LRA. The staff finds that the scope of the program is acceptable since it includes the buried components within the scope of license renewal exposed to an underground environment.

[Preventive Actions] The applicant stated that underground components are coated and wrapped during installation to prevent direct contact with the soil environment. Otherwise, no actions will be taken as part of the buried piping and tanks inspection to prevent aging effects or mitigate age-related degradation. By letter dated March 28, 2003, the staff requested, in RAI B.2.10-1, the applicant to discuss the adequacy of coating techniques. In its response dated June 12, 2003, the applicant stated that VCSNS coats and wraps underground components in accordance with site procedures, available onsite for inspection. These procedures are based on accepted industry standard American Water Works Association (AWWA) C-203, 1973. In addition, operating experience for the diesel generator fuel oil storage tanks revealed negligible wall thinning thereby verifying that the coating and wrapping techniques implemented are effective. The staff subsequently requested the applicant to supply a copy of industry standard AWWA C-203 or its equivalent for review and comparison with the industry standards referenced in the GALL report. During the AMR audit conducted on July 16 - 17, 2003, the staff

received the mechanical maintenance procedure for applying coating on embedded piping. Based on a review of this document, the staff finds this procedure meets the intent of recommended practices of referenced in GALL AMP XI.M34 for surface preparation, application, and inspection of coatings on embedded piping. Therefore, RAI B.2.10-1 is considered closed.

[Parameters Monitored or Inspected] The applicant stated that the condition of coatings and wrappings will be determined by visual inspection whenever buried components are excavated for maintenance or for other reasons. The applicant later cited operating experience with buried piping and tanks, which used the ultrasonic inspection technique (UT). By letter dated March 28, 2003, the staff requested, in RAI B.2.10-2, the applicant to discuss if UT will supplement or replace visual inspection, and the criteria used to determine the applicability of the technique used. In its response dated June 12, 2003, the applicant stated that a visual inspection of the wrapping and coating will be performed and evaluated upon initial excavation of the component. If the wrapping or coating is damaged or removed as part of the maintenance activity, then the underlying metal will be visually inspected for degradation. Depending on the condition of the underlying metal, subsequent inspections and the types of inspections will be determined through the VCSNS Corrective Action Program. Based on the applicant's response, the staff finds that this program will appropriately monitor the parameters directly related to the integrity of the external surface of buried carbon steel piping and tanks. Thus, RAI B.2.10-2 is considered closed.

[Detection of Aging Effects] The applicant claimed that the rate of wall thinning for components within this program is very slow (or negligible). In addition, since the process of excavation itself can damage protective coatings and wrappings, a specific inspection frequency for buried components is not warranted. Instead, if buried components are excavated for maintenance or for other reasons, the integrity of the coatings and wrappings will be evaluated. If the coatings or wrappings are damaged or removed as part of the maintenance activity, the underlying metal will be visually inspected for degradation. By letter dated March 28, 2003, the staff requested, in RAI B.2.10-3, the applicant to discuss why periodic inspection of the most susceptible locations is not needed especially in areas with the highest likelihood of corrosion and/or a history of corrosion problems. In its responses dated June 12, 2003, the applicant stated that GALL AMP XI.M34 allows the inspection frequency to be whenever underground piping is excavated for maintenance depending on operating experience. In addition, VCSNS operating experience has shown no history of corrosion problems for buried piping and tanks, as evidenced by the negligible wall thinning of the diesel fuel oil storage tanks. Therefore, based on this operating experience, the applicant concluded that an inspection frequency based upon scheduled maintenance is justified. The staff finds that the applicant has not adequately demonstrated that periodic inspection, at the most susceptible locations, is unnecessary. In addition, the staff notes that the GALL Report states that the inspection frequency is plant specific and depends on the plant operating experience. Therefore, the staff requested a summary of the most recent excavations, including information about any age-related degradation of systems and components within the scope of this program. In subsequent correspondence dated September 2, 2003, the applicant stated that modification on the Fire Service System piping in 1997 and 1998 required excavation and revealed no external degradation. Based on this most recent operating history and the negligible wall thinning of the diesel fuel oil storage tanks, the staff finds the inspection of buried components during maintenance activities is acceptable. Therefore RAI B.2.10-3 is considered closed.

[Monitoring and Trending] The applicant stated that no actions will be taken as a part of the buried piping and tanks inspection to trend inspection results. The applicant further stated that the results of an inspection may indicate the need for additional inspections to be performed. This need will be dispositioned through the applicant's Corrective Action program. The staff finds that applicant's plan to use the results of previous inspections is a satisfactory approach to identifying susceptible locations.

[Acceptance Criteria] The applicant stated that the acceptance criteria for this program will be "no unacceptable degradation of coatings and wrappings that could result in loss of material and therefore a loss of component intended function, as determined by engineering evaluation." By letter dated March 28, 2003, the staff requested, in RAI B.2.10-4, the applicant to discuss how the coating and wrapping degradation will be reported and evaluated (e.g., by site corrective actions or other procedures). In its response dated June 12, 2003, the applicant stated that any coating and wrapping degradation would be reported and evaluated according to the VCSNS Corrective Action Program.   The staff finds this response acceptable because the degraded conditions will be reported and evaluated through the Corrective Action Program. In addition, the staff finds the applicant's response consistent with the guidance in the GALL report and therefore, RAI B.2.10-4 is considered closed.

[Operating Experience] The applicant stated that the Buried Piping and Tanks Inspection is a new inspection activity. In addition, an inspection of the fuel oil storage tanks and associated piping was performed as a result of the inadequacy of the cathodic protection system for these components. By letter dated March 28, 2003, the staff requested, in RAI B.2.10-5, the applicant to discuss the operating experience and inspection of the other storage tanks and piping within the scope of this system. In its response dated June 12, 2003, the applicant stated that the only buried tanks in scope for license renewal are the diesel fuel oil storage tanks. In addition, the VCSNS operating experience has shown no history of corrosion problems for buried piping. The staff finds the applicant's response acceptable since there is no adverse operating history of the components within the scope of this program. In addition, the staff finds the applicant's response consistent with the guidance in the GALL report and therefore, RAI B.2.10-5 is considered closed.

In summary, based on this review, the staff concluded that the buried Piping and Tanks Inspection program is consistent with the requirements of the 10 elements of Branch Technical Position RLSB-1 in Appendix A of the SRP-LR. The staff confirmed the applicant's claim of consistency during the AMR Audit on July 16 - 17, 2003. The staff verified that this program, as described, is consistent with GALL AMP XI.M34.

Section 18.2.9 of Appendix A to the LRA contains the applicant's FSAR supplement for the Buried Piping and Tanks Inspection program at VCSNS.   The staff reviewed the FSAR supplement and finds that the description of the Buried Piping and Tanks Inspection is consistent with Section B.2.10 of the LRA. In addition, the staff finds that the information contained in the FSAR supplement presents an adequate summary of the program activities as required by 10 CFR 54.21(d).

3.0.3.6.3 Conclusions

On the basis of its review and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are

consistent with the GALL program. Since the GALL program is acceptable to the staff, the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.7 Inspections for Mechanical Components

The Inspections for Mechanical Components program is described in Section B.2.11 of Appendix B in the LRA. The LRA credits this AMP with managing loss of material for the external surfaces of mechanical components constructed of carbon steel, low alloy steel, and other susceptible materials exposed to ambient conditions at VCSNS. The staff reviewed the LRA to determine whether the applicant has demonstrated that the Inspections for Mechanical Components program will adequately manage the applicable aging effect (loss of material) for the components that credit this program during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.0.3.7.1 Summary of Technical Information in the Application

The applicant’s Inspections for Mechanical Components Program is discussed in LRA Section B.2.11, “Inspections for Mechanical Components.” This AMP is not based on a GALL Report AMP. The LRA credits this new inspection program at VCSNS with managing loss of material due to galvanic, general, and pitting corrosion and cracking due to radiation and thermal embrittlement for the external surfaces of those mechanical components within the scope of license renewal that are exposed to ambient conditions. The applicant stated that this program is a condition monitoring program. The inspections for mechanical components manage loss of material and cracking for mechanical components constructed of susceptible materials and exposed to ambient conditions. The inspections involve a visual examination of the exposed external surfaces of representative mechanical components. The inspections and associated evaluations also address conditions in locations susceptible to external pitting corrosion due to the presence of insulation materials and the potential for condensation to occur (FSAR Supplement 18.2.20).

In Section B.2.11 of the LRA, the applicant concluded that the Inspections for Mechanical Components program will provide reasonable assurance that the aging effects will be managed such that the components subject to AMR will continue to perform their intended functions consistent with the CLB during the period of extended operation.

3.0.3.7.2 Staff Evaluation

In LRA Section B.2.11, “Inspections for Mechanical Components,” the applicant described its AMP to manage loss of material due to galvanic, general, and pitting corrosion and cracking due to radiation and thermal embrittlement for the external surfaces of mechanical components. The LRA states that this is a new plant-specific AMP; it is not based on a GALL Report AMP. Therefore, the staff reviewed the program using the guidance in Branch Technical Position (BTP) RLSB-1 in Appendix A to the SRP-LR. The staff’s evaluation focused on managing aging effects through incorporation of the 10 elements described in BTP RLSB-1—program scope, preventive actions, parameters monitored or inspected, detection of aging effects,

monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience. The applicant indicated that the corrective actions, confirmation process, and administrative controls for license renewal are in accordance with the site-controlled Quality Assurance Program. The staff's evaluation of the applicant's Quality Assurance Program is provided separately in Section 3.0.4 of this SER; the evaluation of the remaining seven elements is provided below. The staff also reviewed the FSAR Supplement to determine whether it provides an adequate description of the program.

[Program Scope] The applicant stated that Inspections for Mechanical Components program is a new inspection activity that will manage loss of material due to galvanic, general, and pitting corrosion and cracking due to radiation and thermal embrittlement. The applicant stated that this AMP will manage the relevant aging effects for mechanical components constructed of carbon steel, low-alloy steel, and other susceptible materials in the following mechanical systems:

- air handling (HVAC)
- auxiliary boiler steam and feed-water
- auxiliary coolant (closed loop)/CRDM cooling water
- boron recycle
- building services
- chemical and volume control
- chilled water
- component cooling
- condensate
- demineralized water—nuclear service
- diesel generator services
- emergency feedwater
- extraction steam
- feedwater
- fire service
- gaseous waste processing
- gland sealing steam
- hydrogen removal
- instrument air supply
- liquid waste processing
- local ventilation and cooling
- main steam
- main steam dump
- nitrogen blanketing
- nuclear sampling
- radiation monitoring
- reactor building leak rate testing
- reactor building spray
- reactor coolant
- reactor makeup water supply
- residual heat removal
- safety injection
- service water
- spent fuel cooling
- station service air
- steam generator blowdown
- thermal regeneration

Applicant letter RC-02-0159 dated September 12, 2002 submitted a supplement to include additional systems which meet 10 CFR 54.4(a)(2) criteria. The following systems that meet the refined criteria are not included with the above list of applicable systems in the scope portion of the program/activity evaluation documented in the LRA Appendix B.2.11. These system' pertinent commodities will be addressed by this aging management activity:

- Condenser Air Removal
- Industrial Cooler
- Demineralized Water (non-nuclear services portions)
- Fuel Handling, Oil
- Hydrogen-Nuclear Plant Use
- Leak Detection
- RB Leak Rate Testing
- Nuclear Blowdown Processing
- Nitrogen Blanketing
- Nitrogen-Nuclear Plant Use
- Oxygen-Nuclear Plant Use
- Roof Drains
- Turbine Cycle Sampling
- Sewer

• Non-Nuclear Plant Drains

By letter dated March 28, 2003, the staff stated, in RAI B.2.11-1, that the relevant aging effect of loss of material is identified in Element 1, Program Scope, as being due to galvanic, general, and pitting corrosion. The staff requested clarification since the AMR (LRA Table 3.3-1, Item 5) credits the Inspections for Mechanical Components program with managing loss of material due to MIC. In its response dated June 12, 2003, the applicant stated that the Maintenance Rule Structures Program (AMP B.1.18) manages loss of material due to MIC. The applicant elaborated that plant operating experience has identified the accumulation of microorganisms, due to ground water intrusion effects, on the external surfaces of some piping components at building wall penetrations. Since the VCSNS ground water elevation is approximately 420', piping, process tubing, and ductwork component types were conservatively considered to be susceptible to external MIC if they either enter a building from outside or pass between buildings included in the sheltered environment below the 425' elevation. Therefore, loss of material due to MIC has been identified as an aging effect requiring system-specific evaluation for carbon and low-alloy steel in sheltered environments for piping, process tubing, or ductwork that passes between pertinent buildings through a nonfire seal penetration or enters the building from outside (i.e., underground, embedded) below the 425' elevation. The applicant concluded that building penetrations are inspected as part of the Maintenance Rule Structures Program (LRA B.1.18) and that the VCSNS Corrective Action Program would disposition any ground water in-leakage and resulting degradation.

The staff identified that the VCSNS Maintenance Rule Structures Program, AMP B.1.18, should also address MIC on external surfaces of mechanical components, and that FSAR supplement summary description in Section 18.2.22 be revised to include inspections of building penetrations and associated piping for MIC. By letter dated September 24, 2003, the applicant provided the revised FSAR summary description. Studies by the Electric Power Research Institute (EPRI) conclude that any wetted areas should be considered susceptible to MIC. During a telecommunication with the applicant on July 14, 2003, the staff requested the applicant to justify, including relevant operating experience, why other sources of water (such as water from condensation or water associated with raw water or fuel oil systems) are not considered sources for MIC and why only ground water-related MIC is addressed. The applicant clarified that there are not adequate nutrients to support MIC on external surfaces from sources other than from ground water intrusion. By letter dated September 2, 2003, the applicant confirmed that the ambient environment does not contain nutrients necessary to promote external MIC in other types of water, such as water from condensation. In this letter, the applicant further stated that external MIC has not been found at locations other than at building penetrations. The staff finds that the applicant’s response satisfactorily addresses the staff’s concerns and RAI B.2.11-1 is considered closed.

[Preventive Actions] The applicant stated that no actions are taken as part of this program to prevent the aging effects or to mitigate aging degradation. The staff did not identify the need for such actions because this is a condition monitoring program.

[Parameters Monitored or Inspected] The applicant stated that this AMP involves a visual examination of the exposed external surfaces of mechanical components for loss of material or cracking. By letter dated March 28, 2003, the staff requested, in RAI B.2.11-2, that the applicant expand the description of the program to provide the technical basis for the selection of the component external surfaces to be inspected. The staff asked if these visual

examinations are conducted on an opportunistic basis with external surfaces already exposed and accessible to visual examination during normal operation, or if the examinations include external surfaces at susceptible locations that are exposed to visual examination due to targeted planned actions that may or may not involve suspension of normal operation. The staff requested that the applicant provide the technical basis for determining which additional component external surfaces are to be inspected if unacceptable degradation is observed.

In its response dated June 12, 2003, the applicant stated that the Inspections for Mechanical Components program will generally examine external surfaces already exposed and accessible to visual examination during normal operation.

The applicant also stated that operating experience revealed an instance of external pitting below the insulation on chilled water (VU) system piping. Consequently, loose insulation removal is necessary to permit visual inspection of systems for which the internal fluid temperature is less than the external ambient temperature. The applicant stated that any unacceptable degradation, whether found by these inspections or by planned maintenance activities, would be determined by engineering evaluation and dispositioned in the Corrective Action Program. The applicant concluded that, although the initial frequency for the inspections is 5 years, the Corrective Action Program could increase not only the frequency, but also the scope of the inspections.

The staff required a clarification as to the extent of component surfaces inspected. During a telecommunication on July 14, 2003, the applicant identified that a walkdown is made of all accessible components and any degradation is thoroughly addressed by the Corrective Action Program. By letter dated September 2, 2003, the applicant clarified that the Inspections for Mechanical Components program will inspect external surfaces exposed and accessible to visual inspection during normal operation in addition to removal of insulation to permit visual examinations for systems where the internal fluid temperature is less than the ambient temperature and the insulation is not tightly adhered to the components. The staff finds that the applicant's response satisfactorily addresses the staff's concerns and RAI B.2.11-2 is considered closed.

[Detection of Aging Effects] The applicant stated that, in accordance with guidance in Element 5, "Detection of Aging Effects" for AMPs, the AMP will detect loss of material and cracking prior to loss of component intended function. The applicant further stated that pitting is a concern in locations where components are insulated and internal system fluid temperatures are below the ambient temperature conditions. The staff finds that these inspection techniques are sufficient to provide reasonable assurance that the aging effects for the components managed by the Inspections for Mechanical Components program will be detected and evaluated before a component has lost its intended function.

[Monitoring and Trending] The applicant stated that the inspections will be performed and documented in accordance with station procedures and, following baseline inspection, the frequency of inspections will be determined based on inspection results and industry experience. By letter dated March 28, 2003, the staff requested, in RAI B.2.11-4, that the applicant provide the schedule for the baseline inspection. In its response dated June 12, 2003, the applicant stated that inspections follow the same frequency as maintenance rule structures inspections (5 years) and the baseline inspection would occur within 5 years of obtaining the new license. Based upon the results of these inspections, or any new industry

experience, the frequency may increase. The applicant also confirmed that “effective components,” as written in Element 7, “Monitoring and Trending” for AMPs, should be corrected to “affected components.” The staff finds that the applicant described and justified the inspection frequency. Thus, the staff finds that the applicant’s response satisfactorily addresses its concerns and RAI B.2.11-4 is considered closed. The staff finds that the overall monitoring and trending proposed by the applicant is acceptable because periodic inspections performed in accordance with station procedures will effect timely corrective actions.

[Acceptance Criteria] The applicant stated that the acceptance criterion is that no unacceptable visible indications of loss of material or cracking exist. The applicant further stated that an indication of a rate of deterioration due to loss of material or cracking that could cause the component to fail its intended function prior to its next scheduled inspection, as determined by engineering evaluation, is considered unacceptable. The staff considers the acceptance criteria to be adequate to assure that the intended functions for components in the Inspections for Mechanical Components program will be maintained under all CLB design conditions during the period of extended operation.

By letter dated March 28, 2003, the staff stated, in RAI B.2.11-3, that the SRP-LR Section A.1.2.3.6 indicates that qualitative inspections should be performed to some predetermined criteria as quantitative inspections by personnel in accordance with American Society of Mechanical Engineers (ASME) Code and through site-specific programs. The staff therefore requested the applicant to stipulate the qualifications of inspection personnel conducting the “visual examination of the exposed external surfaces of mechanical components for loss of material or cracking.”   In its response dated June 12, 2003, the applicant stated that site engineering personnel will perform the visual inspections and that any degradation found during the visual inspections would be dispositioned through the VCSNS Corrective Action Program. The applicant stated that further inspections and qualifications required for these inspections would be determined through the Corrective Action Program, which generally requires inspection by quality control personnel qualified in accordance with ASME Code and 10 CFR Part 50 Appendix B. This response did not identify the qualifications of the personnel performing the initial inspection. During a telecommunication on July 14, 2003, the applicant identified that actual system engineers perform the initial walkdowns who observe and report any degradation or abnormality. By letter dated September 2, 2003, the applicant clarified that site engineering personnel (rather than system engineers) will perform visual inspections to specific developed criteria. The staff finds that the applicant’s response satisfactorily addresses the staff’s concerns and RAI B.2.11-3 is considered closed.

[Operating Experience] The applicant stated that the Inspections for Mechanical Components program is a new inspection activity. The applicant also described relevant operating experience with the identification of pitting below the insulation in the chilled water system, which were detected and repaired under existing inspection activities, and several instances of leakage in the chilled water system, which were identified by surveillance procedures. By letter dated March 28, 2003, the staff requested, in RAI B.2.11-5, that the applicant discuss any additional operating experience relevant to the systems within scope, or provide confirmation that this is the only system in the scope of this program with observed degraded conditions. In its response dated June 12, 2003, the applicant stated that Inspections for Mechanical Components program were developed because it was determined that the aging effects were possible—not because they were found at VCSNS. The particular industry operating experience concerning the chilled water system was included because it demonstrates the

effectiveness of the industry-wide operating experience research conducted by VCSNS on possible aging effects for various material-environment combinations. Using industry references, it was determined that, because of the relatively unpolluted environment of the area, contaminants would not concentrate in sufficient quantities to cause pitting corrosion. However, the operating history search at VCSNS revealed that pitting has occurred under insulation in the chilled water system and therefore it is included as an aging effect to be managed. The staff finds that the applicant described and justified the findings from its historical evaluation of operating history. Thus, the staff finds that the applicant's response satisfactorily addresses the staff's concerns and RAI B.2.11-5 is considered closed.

By letter dated March 28, 2003, the staff stated, in RAI B.2.11-6, that the Inspections for Mechanical Components program is credited for managing loss of material of the chilled water expansion tanks (LRA Table 3.3-1, AMR Item 5). The staff stated that GALL AMP XI.M29 addresses aboveground carbon steel tanks, including inaccessible areas, but the VCSNS LRA does not include this program. The staff requested that the applicant describe how the Inspections for Mechanical Components program addresses aboveground carbon steel tanks, including inaccessible locations, and other elements addressed in AMP XI.M29. In its response dated June 12, 2003, the applicant stated that VCSNS does not use GALL AMP XI.M29. The applicant further stated that the chilled water (VU) expansion tanks are elevated such that the bottoms are accessible; however, in other instances, conditions of inaccessible locations can be inferred from the external conditions of accessible locations that are closest to the subject component. Tanks are elevated, usually on elevated concrete pads, so that any accumulations on the floor around a tank does not affect it. It is expected that, should there be any external degradation of tank bottoms for the tanks on concrete pads, there would be telltale signs down the sides of the elevated pad which would be addressed by the Corrective Action Program.

The applicant also stated that any general corrosion on inaccessible tank bottoms would degrade no further than an initial oxide layer, which would provide protection from further general corrosion. The staff is concerned that inaccessible surfaces of outdoor tanks may not have a verification program, such as a thickness measurement, as required by GALL XI.M29. During a telecommunication with the applicant on July 14, 2003, the staff requested further technical justification for not measuring wall thickness in outdoor carbon steel tanks, such as the condensate storage tank, to conclude that significant degradation does not occur in inaccessible areas. The staff identified that inaccessible areas for the condensate storage tank are being addressed by RAI 3.4-13. By letter dated September 2, 2003, the applicant clarified that the condensate storage tank is the only carbon steel tank in a yard environment with an inaccessible bottom. The staff finds that the applicant's response satisfactorily addresses the staff's concerns and RAI B.2.11-6 is considered closed.

By letter dated March 28, 2003, the staff stated in RAI B.2.11-7 that the Inspections for Mechanical Components AMP is credited for managing loss of material due to general corrosion and crack initiation and growth caused by cyclic loading and stress-corrosion cracking (SCC) of the carbon and alloy steel component/component types and inherently addresses their closure bolting in the auxiliary systems (AS) and the steam and power conversion (SPC) systems. The staff noted that in Table 3.2-1, AMR Item12 (engineered safety features (ESF)); Table 3.3-1, AMR Item 23 (AS); and Table 3.4-1, AMR Item 8 (SPC), the LRA states that the specific bolting/fasteners materials within the scope of license renewal were not itemized as a separate non-Class 1 component/component types. Rather, bolting was treated as "piece-part"

(or subcomponent/sub-part) of non-Class 1 components/component types. The staff stated that the GALL Report credits AMP XI. M18, "Bolting Integrity," for monitoring loss of material, cracking, and loss of preload. In addition, accepted bolting integrity programs (such as EPRI 104213) recommend monitoring for loss of preload as one of the parameters monitored or inspected. Monitoring for cracking of high-strength bolts (actual yield strength equal or greater than 150 ksi) is also recommended. The staff subsequently requested the applicant to do the following:

- Identify the AMP that will manage the aging effects for ESF closure bolting (Table 3.2-1, Item 12).
- Justify how the AMPs credited in the VCSNS LRA for bolting are consistent with the Bolting Integrity AMP.
- Provide justification for concluding that loss of preload is not an applicable aging effect.
- Confirm whether high-strength bolts are included within the boundary of these three systems (engineered safety features, auxiliary, and steam and power conversion).

In its response dated June 12, 2003, the applicant stated that for bolted closures (i.e., pressure-retaining) of components/component types subject to AMR, the design of critical closure joint bolting involves enough redundancy to ensure joint integrity. The applicant stated that no aging effects unique to bolting, over the components being joined/closed, require evaluation for license renewal (discussed further below). The applicant stated that external aging degradation of carbon and low-alloy steel components will be managed by the Inspections for Mechanical Components program and, in locations where susceptible, the Boric Acid Corrosion Surveillances program.

The applicant stated that, although identified as an aging effect in various industry references, loss of mechanical closure integrity is not considered to be an aging effect requiring evaluation for non-Class 1 component bolted closures (i.e., pressure boundary closures) within the scope of license renewal.

The applicant stated that mechanical components within the scope of license renewal, both Class 1 and non-Class 1, contain bolted closures that are necessary for the pressure boundary of the components being joined/closed. As such, the bolted closure (including fastener set) was considered to be a subcomponent (piece-part) of the components/component types within the scope of license renewal and did not usually require evaluation separate from the component.

The applicant identified that loss of mechanical closure integrity could result in failure of the mechanical joint, evidenced by leakage rather than joint failure. The applicant stated that this loss of mechanical closure integrity can be attributed to one or more of the following effects—loss of bolt preload (embedment, cyclic load embedment, gasket creep, etc.), loss of bolting material (from general and/or boric acid corrosion), reduction of bolting material fracture toughness, and cracking of high-strength bolting material.

For non-Class 1 bolted closures, loss of preload was considered to be the result of inadequate design or improper assembly (i.e., event-driven) that is not related to aging and that would

manifest itself during the current operating term and be corrected prior to the period of extended operation.

Thus, the applicant claimed that the mechanisms associated with loss of bolting preload are not a license renewal concern for non-Class 1 components/component types.

The applicant stated that loss of bolting material could ultimately result in the loss of a component's pressure boundary integrity; this requires evaluation for license renewal. However, loss of material is an aging effect requiring license renewal evaluation for carbon and alloy steel components/component types subject to AMR. As such, no evaluation separate from the subject components/component types is necessary and, for carbon and alloy steel components/component types, the AMPs credited for managing external general corrosion will inherently address their fasteners.

Furthermore, the applicant stated that stainless steel fasteners are immune to loss of material due to general corrosion. The applicant stated bolting is normally in a dry environment and is coated with a lubricant, thus general corrosion of carbon and alloy steel bolting is not an issue. As is the case with components of similar material, the occurrence of general corrosion in carbon and low-alloy steel fastener sets in the ambient environments is most likely in systems with operating temperatures below ambient conditions that result in condensation, and in the yard environment with repeated wetting/drying from outdoor exposure.

The applicant stated that loss of material due to boric acid wastage (aggressive chemical attack) is the most common aging effect that has been observed in the industry for ferritic fasteners. The Boric Acid Corrosion Surveillances AMP, credited for managing external aging of carbon and low-alloy steel in locations susceptible to leaking borated water, will also address carbon and low-alloy steel fasteners in that location. Additionally, the applicant stated that the Inspections for Mechanical Components program will address any general corrosion concerns for carbon or low-alloy steel bolting in stainless steel components or component types.

The applicant stated that reduction of fracture toughness of bolting material, caused by thermal/neutron effects, is a license renewal concern for the fasteners of components only due to the associated elevated system operating temperatures and proximity to the reactor vessel (RV) beltline region. This is applicable to bolting of some Class 1 components and is addressed in the application. The applicant stated that reduction of fracture toughness for non-Class 1 bolting material is not a license renewal aging effect requiring management for the fasteners of components.

The applicant stated that SCC of bolting materials is a condition in which a fastener that is statically loaded well below the material yield strength may suddenly fail. SCC-induced bolted closure fastener failures have occurred in materials with apparently normal chemical and mechanical properties. Although there have been a few industry instances of SCC-induced bolting cracking, the applicant stressed that these have been attributed to high yield stress materials and contaminants, such as the use of molybdenum disulfide (MoS2)-lubricants, which VCSNS has not and does not use. Most bolting is normally in a dry environment and is coated with a lubricant; in general, environmental conditions that could lead to SCC of bolting are not expected to occur in non-Class 1 components. For quenched and tempered low-alloy steels used for closure bolting (e.g., SA193 Grade B7), having lower yield strength minimizes material susceptibility to SCC. EPRI Report NP-5769 (Volume I, page 11-5) indicates that SCC should

not be a concern for closure bolting in nuclear power plant applications if the specified yield strength is below 150 ksi. The specification for the fabrication of nuclear piping specifies alloy steel ASME SA 193, Class B7 bolts/studs, and ASME 194 Grade 2H nuts, which have minimum yield strengths below 150 ksi (105 ksi). A minimum yield strength for bolting does not, in and of itself, preclude SCC since the actual yield strength of the bolt could be above the threshold value for SCC of low-alloy steel bolting/fasteners to occur (150 ksi). However, sound maintenance bolt torquing practices can control bolting material stresses and the use of appropriate material (such as ASTM A193 Gr. B7) for bolting reduces the potential for SCC to occur. The applicant stated that a review of industry failure databases and NRC generic communications supports the fact that proper material selection, proper maintenance and torquing procedures, and removal of contaminants from lubricants have been effective in eliminating the potential for SCC of bolting materials. The applicant stated that, as documented in NRC Inspection Report No. 50-395/84-08, dated April 20, 1984, the recommended preventive measures and practices of Inspection and Enforcement Bulletin (IEB) 82-02 have been incorporated into the maintenance procedures at VCSNS. Therefore, the applicant stated that SCC of bolting materials is not an aging effect requiring evaluation for license renewal for non-Class 1 component types.

The applicant appropriately identified that loss of mechanical closure integrity due to aggressive attack is an applicable effect for the carbon steel non-Class 1 bolting in the same manner it identified that the aging effect was applicable to the reactor coolant system (RCS) Class 1 bolting fabricated from low-alloy steel. The Boric Acid Corrosion Surveillances and Inspections for Mechanical Components programs are credited with managing loss of material for bolting. The applicant also addressed SCC and concluded that it is not an aging effect requiring further evaluation on the basis of recommended preventive and maintenance practices consistent with IEB 82-02. However, the applicant did not identify that loss of mechanical closure integrity is an applicable aging effect for non-Class 1 bolting materials as a result of stress relaxation in high temperature systems. It is expected that system temperatures may not exceed the threshold where stress relaxation could occur.

During a conference call with the applicant on July 14, 2003, the staff requested the applicant to supplement the RAI response and provide further justification for not addressing loss of preload due to stress relaxation for high temperature systems. By letter dated September 2, 2003, the applicant clarified that, since the operating temperature is below the threshold temperature of 700F, stress relaxation was not identified as an applicable aging effect mechanism for bolts in non-Class 1 RCS bolted connections. The staff finds that the applicant’s response satisfactorily addresses the staff’s concerns and RAI B.2.11-7 is considered closed.

Section 18.2.20 of Appendix A to the LRA contains the applicant’s FSAR Supplement for the Inspections for Mechanical Components program at VCSNS. The staff reviewed the FSAR Supplement and found that the description of this program is consistent with Section B.2.11 of the LRA. The staff finds that the information contained in the FSAR Supplement presents an adequate summary of the program activities as required by 10 CFR 54.21(d).

3.0.3.7.3 Conclusions

On the basis of its review of the applicant’s program, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended

functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.8 Heat Exchanger Inspections

The Heat Exchanger Inspections program is described in Section B.2.12, of Appendix B in the LRA. The LRA credits this AMP with detecting and characterizing loss of material for copper, copper-nickel, and brass heat exchanger components exposed to a treated water environment in the air handling, component cooling, chemical and volume control, diesel generator, emergency feedwater, chilled water, and local ventilation and cooling systems at VCSNS. The staff reviewed the LRA to determine whether the applicant has demonstrated that the Heat Exchanger Inspections program will adequately manage the applicable aging effect (loss of material) for the components that credit this program during the period of extended operation, as required by 10 CFR 54.21 (a)(3).

3.0.3.8.1 Summary of Technical Information in the Application

The applicant's Heat Exchanger Inspections (HEI) program is discussed in LRA Section B.2.12, "Heat Exchanger Inspections." The applicant stated that this is a new program and summarized the program in terms of the 10 elements as described in BTP RLSB in Appendix A to the SRP-LR. The LRA credits this inspection with detecting and characterizing loss of material due to selective leaching and flow-accelerated corrosion (FAC) (i.e., erosion/corrosion in the LRA), as well as heat exchanger fouling due to particulates for heat exchanger components in a treated water environment at VCSNS. The applicant states that the Heat Exchanger Inspections AMP is a new one-time inspection activity that will determine if aging management is required for certain malleable heat exchanger components during the period of extended operation. The Heat Exchanger Inspections program will detect and characterize loss of material due to selective leaching and FAC, as well as particulate fouling. The heat exchanger inspections will use a combination of volumetric and visual examination and hardness measurement techniques at the most susceptible (sample) locations (FSAR Supplement 18.2.40). The applicant stated that the Heat Exchanger Inspections program will be consistent with GALL AMP XI.M32, "One-Time Inspection," and GALL AMP XI.M33, "Selective Leaching of Materials," as identified in the GALL Report. The applicant also stated that this one-time inspection will be performed prior to the period of extended operation.

In Section B.2.12 of the LRA, the applicant concluded that the implementation of the Heat Exchanger Inspections program will either confirm that there are no aging effects requiring management for the subject components or ensure that appropriate corrective actions will be taken so that the component intended functions will be maintained for the period of extended operation.

3.0.3.8.2 Staff Evaluation

In LRA Section B.2.12, "Heat Exchanger Inspections," the applicant described its AMP to manage loss of material due to selective leaching and FAC (i.e., erosion/corrosion in the LRA), as well as heat exchanger fouling due to particulates for heat exchanger components in a treated water environment. The staff reviewed the information in Section B.2.12 of Appendix B

to the LRA, the summary description of the program in the FSAR Supplement (Section 18.2.40 of Appendix A to the LRA), and the applicant's responses to the staff's RAIs. Since the applicant stated that the HEI program is a new one-time inspection consistent with GALL AMPs XI.M32 and XI.M33, the staff's evaluation of this program, is based on the 10 element program described in BTP RLSB in Appendix A to the SRP-LR. The ten program elements in the GALL AMP for one-time inspection supply detailed programmatic characteristics and criteria that the staff considers necessary to confer additional assurance that either aging is not occurring or the evidence of aging is so insignificant that an AMP is not warranted. The ten program elements in GALL AMP XI.M33 include a one-time visual inspection and hardness measurement of selected components that may be susceptible to selective leaching to determine whether loss of materials due to selective leaching is occurring, and whether the process will affect the ability of the components to perform their intended function during the period of extended operation.

The staff's evaluation focused on management of aging effects through incorporation of the following 10 elements from BTP RLSB-1—program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience. The applicant indicated that the corrective actions, confirmation process, and administrative controls for license renewal are in accordance with the site-controlled Quality Assurance Program. The staff's evaluation of the applicant's Quality Assurance Program is provided separately in Section 3.0.4 of this SER. The evaluation of the remaining seven elements is provided below. The staff also reviewed the FSAR Supplement to determine whether it provides an adequate description of the program.

[Program Scope] The applicant stated that this AMP is applicable to copper, copper-nickel, and brass heat exchanger components (as well as brass thermowells) exposed to a treated water environment in the air handling system, CCWS, chemical and volume control system, diesel generator system, emergency feedwater system, chilled water system, and local ventilation and cooling system. The staff finds that the components monitored by the HEI program, as listed above and in Section B.2.12 of the LRA, cover the scope of license renewal as identified in Section 2.3 of the LRA. The scope is acceptable to the staff because it includes those components that rely on the program for aging management.

[Preventive Actions] The applicant stated that no actions are taken as part of this program to prevent the aging effects or to mitigate aging degradation. The staff did not identify the need for such actions.

[Parameters Monitored or Inspected] The applicant stated that the parameters inspected as part of this AMP include wall thickness as a measure of loss of material, material hardness as a measure of selective leaching, and visual evidence of loss of material, heat exchanger fouling, or other age-related degradation. The staff finds the above parameters acceptable because they are directly related to the degradation of copper, copper-nickel, and brass heat exchanger components in the specified VCSNS systems.

[Detection of Aging Effects] The applicant stated that this AMP will use a combination of proven volumetric and visual examination techniques at sample locations in the various heat exchangers determined by engineering evaluation to be most susceptible to the applicable aging effects. The applicant stated that if no parameters are known that would distinguish the susceptible locations, sample locations will be selected based on accessibility and radiological

concerns, and the results will be applied to the associated components. The inspection will include a Brinnell Hardness Test, or equivalent, on a sample of susceptible components in order to characterize a reduction of material hardness (loss of material) due to selective leaching. Further, the applicant stated that the heat exchanger inspections will detect the presence and extent of any loss of material and heat exchanger fouling prior to a loss of component intended function. Inspection locations for heat exchanger fouling should focus on heat exchanger components having an intended function of heat transfer and which are normally in a standby condition with no flow.

The HEI program is credited in LRA Section B.2.12 with detecting and characterizing loss of material due to selective leaching and FAC, as well as heat exchanger fouling due to particulates, for heat exchanger components in a treated water environment. By letter dated March 28, 2003, the staff requested, in RAI B.2.12-1, that the applicant clarify management of galvanic corrosion of heat exchanger tubes. In its response dated June 12, 2003, the applicant stated that the heat exchanger inspections target certain aging effects for components in a treated water environment. The applicant further stated that HEI program is being developed to manage aging effects that are not already managed by other programs; the Chemistry Program is credited to manage galvanic corrosion. EPRI Report 1003056, Appendix A, states that treated water is a poor electrolyte, but concludes that components in treated water systems may exhibit galvanic corrosion. The report identifies five methods for eliminating or minimizing galvanic corrosion. During a telecommunication on July 14, 2003, the applicant identified that chemical purity specifications assure that treated water is maintained within a range that controls galvanic corrosion. By letter dated September 2, 2003, the applicant identified that the makeup water for these systems is supplied from the demineralized water system with a specified cation conductivity less than 1.0μmho/cm. In this response, the applicant also stated that VCSNS has no history of galvanic corrosion of components in these systems and maintains that by following EPRI guidelines for chemistry control of these systems the Chemistry Program manages galvanic corrosion in these systems. The staff finds that the applicant's response satisfactorily addresses the staff's concerns and RAI B.2.12-1 is considered closed.

By letter dated March 28, 2003, the staff requested, in RAI B.2.12-2, that the applicant discuss whether the Chemistry Program and HEI program are used together to manage applicable aging effects for all heat exchanger components in the component cooling water system (CCWS). The staff stated that the LRA is unclear on this point because the Chemistry Program explicitly exempts one-time inspection, but the LRA states that the Heat Exchanger Inspections Program is consistent with GALL AMPs XI.M32 and XI.M33. The staff also requested that the applicant discuss whether the HEI program is used to verify the effectiveness of the Chemistry Program for the applicable aging effects.

In its response dated June 12, 2003, the applicant stated that the heat exchanger inspections AMP addresses particular aging effects for specified materials in a treated water environment and that the purpose of the inspections is to manage aging effects not managed by any other program. For the components encompassed by the HEI program, the Chemistry Program would not manage loss of material due to leaching and FAC for certain materials, thus the HEI program is necessary to manage those aging effects. [The applicant added that since the Chemistry Program is credited with managing heat exchanger fouling, the heat exchanger inspections can serve to demonstrate the effectiveness of the Chemistry Program for that particular aging effect]. The staff notes that the applicant has demonstrated that the Chemistry

Program has proven effective in managing aging effects in a treated water environment as evidenced by review of operating history in response to NRC Generic Letter (GL) 89-13. Since the applicant has also stated that, prior to the period of extended operation, one-time inspections will be conducted in low-flow areas of the various closed, treated water systems to demonstrate the effectiveness of the Chemistry Program, the staff's concerns are resolved, and RAI B.2.12-2 is considered closed.

By letter dated March 28, 2003, the staff requested, in RAI B.2.12-3, that the applicant discuss how the results of sampling would be taken into account for any future inspections (monitoring). In its response dated June 12, 2003, the applicant stated that, depending on the condition of the component as determined by engineering evaluation, subsequent inspections would be determined through the VCSNS Corrective Action Program. Should aging effects be detected that require subsequent inspections, these inspections would be at the locations previously inspected. The staff requires additional information to evaluate the ability of monitoring to detect aging effects prior to loss of function. In a telecommunication on July 14, 2003, the staff requested that the applicant provide more specific information about techniques to sample susceptible areas and inaccessible areas, such as channel head components, motor cooler heat exchangers, tubesheets, and tube bundles. By letter dated September 2, 2003, the applicant stated that representative locations for these inspections would be based on the combination of susceptible materials and chemistry regime. This response also identified that no channel head components are susceptible to the aging effects/mechanisms and the majority of the susceptible components are tubes for various heat exchangers in treated water systems, as well as several thermowells in the diesel generator services system and the tubesheets for the upper reactor coolant pump motor oil coolers. The applicant also stated that present methods for inspecting tubes include volumetric examinations (e.g. eddy current testing) and visual examinations (e.g. boroscopic inspections). Further, the applicant identified that present methods for inspecting loss of material for thermowells include visual inspections and hardness testing (e.g. Brinell hardness testing). The staff finds that the applicant's response satisfactorily addresses the staff's concerns and RAI B.2.12-3 is considered closed.

The use of one-time inspection is appropriate for inspections where degradation is possible, but is not expected based on plant-specific and industry operating experience. This one-time inspection provides for additional inspections should the corrective action process require additional information to characterize the aging effects.

[Monitoring and Trending] The applicant stated that no actions are taken as a part of the HEI program to trend inspection results. This is a one-time inspection used to determine if further actions are required. The staff did not identify the need for such actions.

[Acceptance Criteria] The applicant stated that the acceptance criteria are (1) no unacceptable loss of material or (2) heat exchanger fouling of the subject components that could result in a loss of the component intended function, as determined by engineering evaluation. By letter dated March 28, 2003, the staff requested, in RAI B.2.12-4, that the applicant elaborate on the acceptance criteria applied in the engineering evaluation with consideration to the rate of damage and explain how a determination of no unacceptable loss of material or fouling of subject components can be made on the basis of a one-time inspection. In its response dated June 12, 2003, the applicant stated that any loss of material would be determined by engineering evaluation based on the design of the individual component and, where applicable, on the results of the hardness testing. Although the Chemistry Program controls heat

exchanger fouling due to particulates, the heat exchanger inspections are an additional verification of the effectiveness of the Chemistry Program. Any heat exchanger fouling will be determined by engineering evaluation based on visual examination. Loss of material or heat exchanger fouling would be evaluated and documented in the VCSNS Corrective Action Program, with subsequent actions or inspections determined through the Corrective Action Program. The applicant concluded that, if aging effects are detected that require subsequent inspections, these inspections would be at previously inspected locations to be able to determine damage kinetics. The staff is concerned that loss of heat transfer may not be detected by visual examination for fouling prior to loss of the intended function. In a telecommunication dated July 14, 2003, the applicant identified that no tube aging effects have been observed and that heat transfer may not be a safety function for the heat exchangers included in the HEI program. By letter dated September 2, 2003, the applicant stated that the visual examination for fouling, possibly through the use of a boroscope, will be performed on a sample of heat exchanger tubes based on chemistry regime. The applicant also stated that it is reasonable that the results of the examination would be indicative of the fouling for the tubes of the other heat exchangers for that chemistry regime. Considering that heat exchanger fouling will be determined by engineering evaluation based on visual examination, the staff finds that the applicant's response satisfactorily addresses the staff's concerns and RAI B.2.12-4 is considered closed.

[Operating Experience] The applicant stated that the HEI program is a new one-time inspection for which there is no operating experience. By letter dated March 28, 2003, the staff requested, in RAI B.2.12-5, that the applicant clarify any relevant operating experience for the systems that will be managed by this program. In its response dated June 12, 2003, the applicant stated that operating experience, both site-specific and industry-wide, was researched to identify the possible aging effects for various combinations of material and environment. This new HEI program was developed because it was determined that the aging effects were possible—not because these aging effects were found at VCSNS. At VCSNS, there is no history of selective leaching, FAC, or heat exchanger fouling occurring for the components managed by this program. The staff is concerned that aging effects may not be evident unless maintenance records are reviewed. During a telecommunication on July 14, 2003, the applicant identified that maintenance records were not reviewed, but that no unacceptable degradation was reported, fouling was only a problem for open-cycle cooling because the maintenance programs have prevented any problems with closed cycle cooling system (components cooled with very clean chilled water). By letter dated September 2, 2003, the applicant stated that the makeup water is demineralized water and in these closed systems there is no other pathway for the introduction of contaminants beyond the corrosion products of the system and the addition of corrosion inhibitors. Considering that one-time inspections will be used to verify the effectiveness of the chemistry program, the staff finds that the applicant's response satisfactorily addresses the staff's concerns and RAI B.2.12-4 is considered closed.

Section 18.2.40 of Appendix A to the LRA contains the applicant's FSAR Supplement for the heat exchanger inspections at VCSNS. The staff reviewed the FSAR Supplement and found that the description of the HEI program is consistent with Section B.2.12 of the LRA. The staff finds that the information contained in the FSAR Supplement presents an adequate summary of the program activities as required by 10 CFR 54.21(d).

3.0.3.8.3 Conclusions

On the basis of its review and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.9 Area-Based Inspections for Refined 10 CFR 54.4(a)(2) Criteria

3.0.3.9.1 Summary of Technical Information in the Application

The applicant's Area-Based Inspections for Refined 10 CFR 54.4(a)(2) Criteria program is described in Appendix B.2.13 of the document "Criteria 2 Supplement to the Application for Renewed Operating License for VCSNS" submitted by applicant's letter dated September 12, 2002. The LRA Criteria 2 Supplement credits this new one-time inspection program VCSNS with detecting and characterizing loss of material due to general, crevice, and pitting corrosion resulting from exposure of carbon steel pipe to an unmonitored and uncontrolled water environment (such as rainwater, leaking ground water and water drained from equipment).

In Section B.2.13 of the document, "Criteria 2 Supplement to the Application for Renewed Operating License for VCSNS," the applicant states that implementation of the Area-Based Inspections for Refined 10 CFR 54.4(a)(2) Criteria program will either verify that there are no aging effects requiring management for the subject components or appropriate corrective actions will be taken so that the component intended functions will be ensured during the period of extended operation.

3.0.3.9.2 Staff Evaluation

In Section B.2.13 of Appendix B to the document, "Criteria 2 Supplement to the Application for Renewed Operating License for VCSNS," the applicant describes its AMP to manage loss of material due to general crevice and pitting, corrosion from exposure to an unmonitored and uncontrolled water environment. The applicant stated that this is a new one-time inspection. Therefore, the staff reviewed the program using the guidance in STP RLSB-1 in Appendix A to the SRP-LR. The staff's evaluation focused on managing aging effects through the effective incorporation of ten elements described in NUREG-1800, Appendix A-1 Aging Management Review-Generic (Branch Technical Position RLSB-1), scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrections actions, confirmation process, administrative controls and the operating expertise.

The LRA Criteria 2 Supplement indicates that the corrective actions and confirmation process are implemented through the site corrective actions process, while the administrative controls are implemented through the site procedures. The staff's evaluation of corrective actions, confirmation process, and administrative controls is contained in Section 3.0.4 "Quality Assurance Program" of this SER. The remaining seven (7) elements are evaluated below. The staff also reviewed the FSAR supplement to determine whether it provides an adequate description of the program.

[Program Scope] The applicant stated that the Area-Based Inspections for Refined 10 CFR 54.4(A)(2) Criteria is a new inspection activity that will detect and characterize loss of material due to general, crevice, and pitting corrosion resulting from exposure of carbon steel pipe to an unmonitored and uncontrolled water environment (such as rainwater, leaking ground water and water drained from equipment). The applicant states that this AMP will manage the relevant aging effect for carbon steel pipe in the following systems: steam dump discharge piping, non-nuclear plant drains, main steam safety and relief valve discharge piping, roof drains, and sewer. The scope is acceptable to the staff because it includes those components that rely on the program for aging management.

[Preventive Actions] The applicant states that no actions are taken as part of this program to prevent the aging effects or to mitigate aging degradation. The staff did not identify the need for such actions.

[Parameters Monitored or Inspected] The applicant states that this AMP inspects wall thickness as a measure of loss of material, and visual evidence of loss of material or other age-related degradation. The staff finds the above parameters acceptable because they are directly related to the degradation of carbon steel pipe exposed to an uncontrolled water environment in the specified VCSNS systems.

[Detection of Aging Effects] The applicant states that this AMP will use a combination of volumetric and visual examination techniques at sample locations in the drain lines determined by engineering evaluation to be most susceptible to the applicable aging effects. The applicant further states that as no parameters are known that would distinguish the susceptible locations, sample locations will be selected based on accessibility and radiological concerns, and the results applied to the associated piping. The applicant states that this AMP will detect the presence and extent of any loss of material prior to a loss of component intended function and the effective and proven volumetric and visual examination techniques will be selected for use in performing the inspection. In a conference call on September 16, 2003, the staff requested, in RAI B.2.13-1, Part a, that the applicant clarify how sample locations would be chosen. The applicant was also asked to clarify if safety and relief valve discharge piping was susceptible to erosion and to identify which systems are exposed to leaking ground water and how MIC is managed for these systems. By letter dated September 24, 2003, the applicant responded by stating that the aging mechanisms are not expected to challenge the structural integrity of these piping systems and a one-time inspection based on accessibility and suitability will determine if corrective actions such as future inspections or repair will be required. The applicant stated that safety and relief valve lines are not subject to erosion due to their limited operating time at design flow rates. The applicant also clarified that only the non-nuclear plant drains are exposed to raw water and MIC induced leakage will be detected and appropriate action taken before the loss of structural integrity. The staff finds that this response satisfactorily addresses the staff’s concerns and RAI B.2.13-1, part a. is closed.

[Monitoring and Trending] The applicant states that no actions are taken as part of the Area Based Inspections for Refined 10 CFR 54.4(a)(2) Criteria to trend inspection results. Furthermore the applicant states that this is a one-time inspection used to determine if further actions are needed. Trending is not applicable to a new one-time inspection.

[Acceptance Criteria] The applicant maintained that the acceptance criteria for the Area Based Inspections for Refined 10 CFR 54.4(a)(2) Criteria is no acceptable loss of material subject

components that could result in a loss of the component intended function(s), as determined by engineering evaluation. However, in the attribute “Corrective Actions” the applicant states that if the engineering evaluation determines that additional information is required to more fully characterize the aging effects, then additional inspections will be completed by other actions taken in order to obtain the additional information.

In RAI B.2.13-1 Part b, the staff requested that the applicant clarify whether evaluation of the inspection results will ensure that the minimum required wall thickness is preserved. By letter dated September 24, 2003, the applicant responded by stating that aging mechanisms are not expected to challenge the structural integrity of these piping systems and that a one-time inspection will be able to predict the potential for through wall leakage occurring for those drains lines over sensitive components. The staff finds that this response satisfactorily addresses the staff’s concerns and RAI B.2.13-1, part b. is closed.

[Operating Experience] The applicant stated that the Area Based Inspections for Refined 10 CFR 54.4(a)(2) Criteria is a new inspection activity for which there is no operating experience. In RAI B.2.13-1 Part c, the staff requested that the applicant clarify any relevant operating experience, both site-specific and industry-wide, for the systems that will be managed by this program. The staff also requested confirmation that the operating experience review includes plant operating and maintenance history for the systems managed by this program, as required by Section 4.2.2.2 of NEI 95-10. By letter dated September 24, 2003, the applicant responded by stating that the operating experience reviews performed identified aging issues regardless of the component’s license renewal intended function and the operating experience identified no new aging effects. This response further clarified that the review of non-conformance notices was performed for a five year period. The staff finds that this response satisfactorily addresses the staff’s concerns and RAI B.2.13-1, part c. is closed.

Section 18.2.26 of the document, “Criteria 2 Supplement to the Application for Renewed Operating License for VCSNS” containing the applicant’s FSAR supplement for the Area Based Inspections for Refined 10 CFR 54.4(a)(2) Criteria is consistent with Section B.2.13 of this Criteria 2 Supplement. The staff finds that the information contained in the FSAR supplement presents an adequate summary of the program activities as required by 10 CFR 54.21(d).

3.0.3.9.3 Conclusion

On the basis of its review, the staff finds that the program adequately addresses the ten program elements defined in Branch Technical Portion RLSB-1 in Appendix A-1 of the SRP-LR, and that the program will adequately manage the aging effects for which it is credited. The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program as required by 10 CFR 54.21(d).

Therefore, on the basis of its review, the staff concludes that there is reasonable assurance that the applicant has demonstrated that the Area Based Inspections for Refined 10 CFR 54.4(a)(2) Criteria will effectively manage aging in the components for which this program is credited, to ensure that the components will perform their intended functions in accordance with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.4 VCSNS Quality Assurance Program

The NRC staff reviewed Appendix B of the LRA, "Aging Management Programs and Activities," in accordance with the requirements of 10 CFR 54.21(a)(3) and 10 CFR 54.21(d). The staff evaluated the adequacy of certain aspects of the applicant's programs to manage the effects of aging, in particular, the three QA Program elements of corrective action, confirmation process, and administrative controls, which the applicant addressed for all of the AMPs. A license renewal applicant is required to demonstrate that the effects of aging on SCs that are subject to an AMR will be adequately managed to ensure that their intended functions will be maintained in a manner that is consistent with the CLB of the facility throughout the period of extended operation. To manage these effects, applicants have developed new, or revised existing, AMPs and applied those programs to the SSCs of interest. For each of these AMPs, the applicant's existing 10 CFR Part 50, Appendix B, Quality Assurance Program (QA) may be used to address.

3.0.4.1 Summary of Technical Information in Application

Section 3.0, "Aging Management Review Results," of the LRA, provides an AMR summary for SCs, or commodity groups, determined during the scoping and screening process to be subject to an AMR. SCs subject to an AMR were evaluated to demonstrate that the effects of aging will be managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation.

Appendix B, Section B.1.0, "Existing Aging Management Activities", and Section B.2.0, "New Aging Management Activities," of the LRA provide the aging management activity description for each of these activities credited for managing aging effects. These activities are based upon the AMR results provided in Sections 3.1 through 3.6 of the LRA. The applicant stated that the existing VCSNS QA program addresses three of the AMP elements (corrective action, confirmation process, and administrative control) for all of its AMPs, implements the requirements of 10 CFR Part 50, Appendix B; and is consistent with the summary in Section A.2 of NUREG-1800. The applicant further stated that these programs, credited for license renewal, encompass both the safety-related and non-safety-related SCs that require aging management during the period of extended operation. AMPs identified as existing or new, in Appendix B, Sections B.1.0 and B.2.0, of the LRA provide descriptions of the specific attributes of corrective action, confirmation process and administrative control. A correlation between NUREG-1801 and the VCSNS programs credited with aging management is provided in Appendix B, Table B-1, of the LRA.

3.0.4.2 Staff Evaluation

The staff evaluated the adequacy of certain aspects of the applicant's programs to manage the effects of aging. The particular aspects reviewed by the staff in this section encompass three QA Program elements, namely corrective action, confirmation process, and administrative control. These three attributes of the QA Program apply to all of the applicant's AMPs. During the scoping and screening methodology audit, performed by the NRC staff during the period January 28—31, 2003, the staff reviewed the applicant's programs described in Appendix A, "FSAR Chapter 18," and Appendix B, "Aging Management Programs and Activities," to assure that the aging management activities were consistent with the staff's guidance described in

Section A.2, "Quality Assurance for Aging Management Programs," and BTP IQMB-1, regarding quality assurance of the SRP-LRA. During the review, the applicant stated that the attributes of corrective action, confirmation process, and administrative control are addressed in the VCSNS QA program and that VCSNS will employ the Corrective Action and Document Control Programs to address these program elements for both safety-related and non-safety-related SCs that require aging management during the period of extended operation. Based on the staff's evaluation, the description and applicability of the AMPs and their associated attributes to all safety-related and non-safety-related SCs provided in Appendix A and Appendix B of the LRA, the applicant's program is consistent with the staff's position regarding quality assurance for aging management. However, the staff noted that the applicant had not sufficiently described the use of the QA Program and its associated attributes (corrective action, confirmation process, and administrative control) in Appendix A of the LRA.

In a letter dated March 28, 2003, the staff submitted RAI 2.1-3 to the applicant, which requested a revision to Appendix A to include a description of the QA Program elements, including references to pertinent guidance, consistent with the level of detail discussed in Appendix B of the LRA. In a letter dated June 16, 2003, the applicant provided a response to the staff's RAI which stated that the VCSNS QA program applies equally to both existing programs and new programs being developed for license renewal, and that generic statements regarding the applicability of the VCSNS QA program will be added to FSAR Section 18.1 for all of the programs credited to manage aging effects for in-scope SSCs. The response also stated that the implementing documents are subject to administrative controls, including a formal review and approval process, and that the confirmation process is part of the AMP implementing procedures and the VCSNS Corrective Action Program. The response stated that the aging management activities required by this program would also identify any unsatisfactory conditions due to ineffective corrective action and that both the implementing documents and the confirmation process are implemented in accordance with the requirements of 10 CFR Part 50, Appendix B, and American National Standards Institute (ANSI) N18.7-1976, "Administrative Controls and Quality Assurance for the Operational Phase of Nuclear Power Plants," as committed to in the FSAR.

Based on its review of the applicant's response to RAI 2.1-3, the staff concludes that the applicant has committed to include a description of the QA program elements consistent with the level of detail currently provided in Appendix B.

3.0.4.3 Conclusions

The staff finds that the quality assurance elements are consistent with 10 CFR 54.21(a)(3) and the staff's BTP IQMB-1. The staff also finds that the applicant's supplemental response and commitment to add generic statements to Appendix A of FSAR Chapter 18, specifically Section 18.1 as discussed above, should provide sufficient description of the QA program attribute and activities for managing the effects of aging as required by 10 CFR 54.21(d). This commitment has also been identified in Appendix A of this SER.

3.0.5 Aging Management Review of Systems, Structures, and Components Under Refined Criterion 2

3.0.5.1 Summary of Technical Information in the Application

The description of the Criteria 2 systems and components can be found in Section 2.3.5 of this SER. The passive, long-lived components in these systems that are subject to an AMR are identified in Section 2.0 of the Criteria 2 Supplement to the LRA submitted by the applicant on September 12, 2002. The components, aging effects, and aging management programs are provided in Table 1 of the Criteria 2 Supplement.

Aging Effects

Tables 1 and Section 2.0 of the Criteria 2 Supplement list individual components including piping and components, insulation, ductwork, and non-mechanical components.

Loss of material due to crevice corrosion, pitting corrosion, and crack initiation and growth from stress corrosion cracking are identified as aging effects for stainless steel components exposed to the environments of treated water, chemically treated borated water, or uncontrolled water. No aging effect is identified for stainless steel, carbon steel, fiberglass insulation, and calcium silicate insulation components exposed to the environment of air-gas. No aging effect is identified for stainless steel and galvanized steel components exposed to the environment of ambient air (dry for galvanized steel). For exposure to the environment of wet ambient air, loss of material due to general and galvanic corrosion is identified as aging effect for galvanized steel components. Loss of material due to boric acid leakage is identified as an aging effect for carbon steel, and galvanized steel components exposed to the environment of ambient air with boric acid leakage. Loss of material due to crevice corrosion, pitting corrosion, and flow accelerated corrosion and crack initiation and growth/ stress corrosion cracking are identified as aging effects for carbon steel components exposed to the environment of treated water. Carbon steel components in a raw water environment has the applicable aging effect of loss of material due to crevice, pitting, general, and galvanic corrosion, as well as microbiologically induced corrosion (MIC) and erosion. Loss of material due to general and/or galvanic corrosion is identified as an aging effect for carbon steel components exposed to the environment of ambient air and uncontrolled water while the additional aging effect due to crevice, and pitting corrosion is applicable to carbon steel components in an environment of uncontrolled water. No aging effect is identified for carbon steel components exposed to the fuel oil environment.

Aging Management Programs

The following AMPs are utilized to manage aging effects in the Criteria 2 systems:

- Boric Acid Corrosion Surveillances (Appendix B.1 .2),
- Chemistry Program (Appendix B.1 .4),
- Flow-Accelerated Corrosion Monitoring Program (Appendix B.1 .6),
- Inspections for Mechanical Components (Appendix B.2.11),
- Service Water System Reliability and In-Service Testing Program (Appendix B.1 .9),
- Area Based Inspections for Refined 10 CFR 54.4(a)(2) Criteria Commodities (Appendix B.2.13).

With the exception of the new AMP B.2.13, “Area Based Inspections for Refined 10 CFR 54.4(a)(2) Criteria Commodities”, these AMPs are existing programs included in Appendix B of the LRA. In Appendix B of the supplemental submittal, the applicant provided additional information to supplement the original program discussion of these existing AMPs. In addition, the applicant provided a detailed description of the new AMP B.2.13. The applicant concluded

that the effect of aging associated with the components of the Criteria 2 systems will be adequately managed by these AMPs during the period of extended operation.

3.0.5.2 Staff Evaluation

<u>Aging Effect</u>

The staff reviewed the information in the Criteria 2 Supplement. During its review, the staff determined that additional information was needed to complete its review.

In Item #6 of Table 1 in Criteria 2 Supplement under the “Discussion” column, the applicant stated that component type listed in Item #6 also includes the internal surface of system components that contain non-dried air. The applicant also stated that these components may experience internal surface corrosion but they are not expected to have a loss of structural integrity. During a telephone conference on September 16, 2003, the staff requested the applicant to provide the basis, including any operating experience, for this conclusion and to clarify whether any of these components has any intended function other than structural integrity.

In addition, the staff noted that the piping systems and components included in Item #6 are a subset of those of Item # 4. For this subset, components, materials and environment (other than external versus internal) are consistent in both items. However, the corresponding AMR (for non-dried air in #6 or moist air in #4) led to different conclusions for components in the two items (#4 and #6) regarding the need for aging management. The staff requested the applicant to provide the basis for the different AMR conclusions for components in these two items.

In its response dated September 24, 2003, the applicant stated that all items included in the Criteria 2 Supplement are included for the concern of potential interaction with safety related SSCs. The requirements for these items are to maintain structural integrity. In addition to structural integrity, a few components over sensitive components like electrical switchgear or motor control centers are required not to leak fluid. VCSNS took a conservative approach to Criteria 2 and included all piping in the areas of seismic concern in scope unless specifically evaluated out. VCSNS also credited existing programs for aging management of added components.

The applicant further stated that the environments included in Table 1, Item #6 are not wet. Table 1, Item #6 includes interior of non-fluid containing carbon steel piping components. The environments include dried air, process gasses (e.g., nitrogen), non-dried compressed air (service air), condenser vacuum pump exhaust and connections for main steam(air removal), and non-dried air from inside the plant. None of these environments is considered “aggressive” and none of these systems’ pressure boundary is required for license renewal. Significant internal corrosion is not expected for these applications, structural integrity will be maintained, and the pressure boundary (though not required) will be maintained. Neither VCSNS nor the industry have had any operating experience to indicate loss of structural integrity is a concern for these material environment combinations.

The applicant clarified that Table 1, Item #4 is the external environment of carbon steel piping systems. The applicant stated that VCSNS has conservatively included Item #4 piping within the scope of the Inspections for Mechanical Components. Inspections for Mechanical

Components is an inspection activity that will manage loss of material due to general and/or galvanic corrosion on the external surface of susceptible materials such as carbon and low alloy steel. The activity involves the visual examination of the exposed external surfaces of mechanical components in areas of the plant containing components/component types in the scope of license renewal. The applicant also stated that the external surfaces of components should be dry and not subject to any significant corrosion; however, condensation, drips, spray, leakage, and other external conditions may lead to aging that could require management. Provisions for removal of insulation to permit visual inspection are provided for selected components. In addition, the applicant stated that this program will identify visible aging effects and utilize the corrective action program to determine the extent and source of the degradation and effect repairs and identify additional actions. Furthermore, the applicant stated that for Table 1 Item 6 piping components that contain air and gasses, drips, spray, and leakage on the internal surface are not postulated. Condensation may occur in air removal piping; however, its effect is limited to corrosion on the bottom of the pipe. The applicant stated that even if a through wall failure were to occur, it will not lead to a structural failure and the Inspections for Mechanical Components will detect the through wall leak and repair the pipe.

Therefore, in a response dated March 15, 2002, the applicant concluded that the VCSNS position on Criteria 2 components were conservative when compared to the staff position on the identification and treatment of structures, systems, and components that meet 10 CFR 54.4(a)(2) dated March 15, 2002. The applicant stated that VCSNS has included all piping, ductwork, and insulation contained in seismic areas of the plant in scope unless it was specifically evaluated out. Finally, the applicant stated that although pressure boundary is not normally required, programs that manage pressure boundaries perform aging management of most components included in the Criteria 2 Supplement.

On the basis of its review, the staff finds the applicant's response acceptable because the applicant has demonstrated that 1) VCSNS took a conservative approach to Criteria 2 and included all piping in the areas of seismic concern in scope unless specifically evaluated out, and that VCSNS has credited existing AMPs including the Inspections for Mechanical Components program to manage the aging effects of the added components; and 2) neither VCSNS nor the industry have had any operating experience to indicate loss of structural integrity is a concern for the material environment combinations included in Table 1 Item 6.

In Item #7 of Table 1 in Criteria 2 Supplement under the "Discussion" column, the applicant stated that raw water is part of uncontrolled water. However, the staff noted that loss of material due to MIC and erosion in the raw water environment are not considered as applicable aging effects/mechanisms for the components in Item #7. The staff also noted that for a combination of components types/materials/environments in Item #11 that is consistent with that of Item #7, loss of material due to MIC and erosion are considered to be applicable aging effects/mechanisms for a raw water environment. During a telephone conference on September 16, 2003, the staff requested the applicant to provide the basis, including applicable operating experience, to justify the different AMR conclusions for components in these two items.

The staff also noted that for the aging management of the components considered in Item #11, the applicant credited the Service Water Reliability and In-Service Testing (B.1.9) to manage the aging effects. For Item #7, the applicant utilized the Area Based Inspections for Refined 10 CFR 54.4(a)(2) Criteria (B.2.13). It should be noted that AMP B.1.9 is consistent with GALL

AMP Open-Cycle Cooling Water System (XI.M20), which includes periodic inspections while AMP B.2.13 uses one-time inspection. The staff requested the applicant to provide the basis, including any applicable operating experience, to justify that periodic inspections are necessary to manage the aging effects for Item #11, whereas one-time inspection is sufficient for the aging management for Item #7.

In its response dated September 24, 2003, the applicant stated that Table 1, Item #7 includes piping environments resulting from uncontrolled sources such as rainwater, leaking ground water and water drained from equipment. For this discussion rainwater is not considered raw water. The applicant also stated that these systems are not subject to erosion based on design and operating conditions. Drain lines have very low flow rates; and safety and relief valves have very limited operating time at design flow rates. The applicant further stated that piping on the discharge of the non-nuclear plant drains [MD] sump pumps is exposed to raw water when equipment is drained or from other sources. The applicant stated that the sump pump discharge piping is the only piping in Item #7 that is normally filled. The applicant also stated that leakage from the sump pump discharge piping is not a concern for license renewal. MIC induced leakage will be detected and appropriate corrective action taken before the loss of structural integrity. In addition, the applicant stated that other MD piping is normally dry or partially wetted by drainage from non-raw water sources, such as condensate from air handling units or rain. Furthermore, the applicant stated that systems included in Table 1, Item #7 (other than MD) are not exposed to raw water.

The applicant emphasized that Area Based Inspections for Refined 10 CFR 54.4(a)(2) Criteria is a new one-time inspection that will detect and characterize loss of material due to general, crevice, and pitting corrosion resulting from exposure to an unmonitored and uncontrolled water environment. If MIC is present it will also be detected. The applicant further stated that the Area Based Inspections for Refined 10 CFR 54.4(a)(2) Criteria was added to manage aging for those components that were not suitable for inclusion into a program identified in the Application. The applicant stated that the aging mechanisms are not expected to challenge the structural integrity of these piping systems; therefore, a one-time inspection approach is applied to confirm this conclusion. For those drain lines over sensitive components a one-time inspection will be to predict the potential for through wall leakage occurring during the 60-year plant life. In addition, the applicant stated that the inspections will determine if corrective actions such as future inspections or repair will be required. Furthermore, the applicant clarified that Inspections for Mechanical Components AMP is applicable for the exterior of these components. Leakage in drain lines or the MD sump pump discharge due to degradation from aging mechanisms such as crevice corrosion, pitting corrosion and MIC, would lead to detectable external leakage prior to a loss of structural integrity. Finally, the applicant clarified that Table 1 Item 11 is applicable to Service Water (SW). SW is a safety related system where pressure boundary is required for license renewal and its aging effects are managed by the Service Water System Reliability and In-service Testing Program.

On the basis of its review, the staff finds the applicant’s response acceptable because the applicant has clarified that 1) MIC induced leakage will be detected and appropriate corrective action taken before the loss of structural integrity, and that systems included in Table 1, Item #7 (other than MD) are not exposed to raw water; 2) the aging mechanisms of general, crevice, pitting corrosion and MIC are not expected to challenge the structural integrity of these piping systems; and therefore, a one-time inspection approach is applied to confirm this conclusion;

and 3) Table 1, Item #11 is applicable to SW for which the Service Water System Reliability and In-service Testing Program will be utilized to manage the aging effects.

In the discussion column of Item #16 of Table 1 in Criteria 2 Supplement, the applicant stated that this grouping included fiberglass piping insulation exposed to a moist air environment. The applicant further stated that at VCSNS the ambient environment did not contain contaminants of sufficient concentration to cause aging effects that require aging management. However, the staff noted that moisture infiltration into the fiberglass insulation materials may over time lead to compression or settling of the fiberglass material. This may in turn lead to a reduction of the insulating properties of the fiberglass. As a result, a different temperature distribution may arise across the layer of fiberglass insulation material with a possibly lower temperature at the piping /insulation interface. This may increase the likelihood of further moisture condensation and consequently surface corrosion of the piping materials. During a telephone conversation on September 16, 2003, the staff requested the applicant to clarify whether this aging effect is applicable to the fiberglass piping insulation material for VCSNS and provide a basis, including operating experience, for its conclusion. In addition, the staff requested the applicant to clarify whether the fiberglass insulation material used at VCSNS has accompanying metal-foil based (such as aluminum) vapor retarder component. If so, some parts of these metal-foil based vapor retarder components may be in contact with the metallic surface (such as carbon steel) of nearby metal piping of different material due to close spatial interaction. In the presence of moisture this may give rise to galvanic corrosion. Therefore, the staff requested the applicant to clarify whether loss of material due to galvanic corrosion is an applicable aging effect at VCSNS arising from the process described above and provide a basis, including operating experience, for its conclusion.

In its response dated September 24, 2003, the applicant stated that Table 1, Item #16 includes fiberglass insulation on both stainless steel and carbon steel piping and ductwork. Fiberglass insulation is used outside the reactor building. Insulation is included in the scope of license renewal for potential interaction only. The insulating properties of insulation are not a license renewal intended function. The applicant further stated that the structural aspects of plant design (protective/mitigative features) that preclude an adverse impact on nuclear safety-related components due to flooding are also in the scope of license renewal. Outside the reactor building, blockage of sumps does not adversely impact the plant flooding evaluations. In addition, the applicant clarified that three (3) types of insulation used inside the reactor building include all stainless steel reflective insulation and two types of mass insulation encapsulated in stainless steel. The stainless steel reflective insulation is used primarily on piping. One type of mass insulation encapsulated in stainless steel is used only around the reactor pressure vessel loop inlet and outlet nozzles and the portions of reactor coolant piping that penetrate the primary shield wall. The other mass type encapsulated in stainless steel is used on the pressurizer and steam generator level and flow instrument tubing. The applicant stated that Insulation within the reactor building is included in Table 1, Item #5. Finally, the applicant clarified that Inspections for Mechanical Components is an inspection activity that will manage loss of material due to general and/or galvanic corrosion on the external surface of susceptible materials such as carbon and low alloy steel. This program will manage effects of condensate leaking from insulation on to carbon steel. The activity involves the visual examination of the exposed external surfaces of mechanical components in areas of the plant containing components/component types in the scope of license renewal. This program will identify visible aging effects and will utilize the Corrective Action Program to effect repairs and identify additional actions.

On the basis of its review, the staff finds the applicant's response acceptable because the applicant has demonstrated that 1) insulation is included in the scope of license renewal for potential interaction only, and that the insulating properties of insulation are not a license renewal intended function; and 2) the Inspections for Mechanical Components AMP will identify visible aging effects and will utilize the Corrective Action Program to effect repairs and identify additional actions.

The aging effects identified in the LRA for systems, structures, and components under refined Criterion 2 are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs

The applicant credited the following AMPs for managing the aging effects in the Criteria 2 systems:

- Boric Acid Corrosion Surveillances (3.0.3.1)
- Chemistry Program (3.0.3.2)
- Flow-Accelerated Corrosion Monitoring Program (3.4.2.4.1),
- Inspections for Mechanical Components (3.0.3.7),
- Service Water System Reliability and In-Service Testing Program (3.3.2.3.1),
- Area Based Inspections for Refined 10 CFR 54.4(a)(2) Criteria Commodities (3.0.3.9).

The Boric Acid Corrosion Surveillances Program, the Chemistry Program, and the Inspections for Mechanical Components are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common aging management programs. The staff has evaluated the additional information provided in the Criteria 2 Supplement for these common AMPs and has found them to be acceptable for managing the aging effects identified for these Criteria 2 systems. The staff's evaluation of these AMPs is documented in Sections 3.0.3.1, 3.0.3.2, and 3.0.3.7 of this SER.

The staff has evaluated the additional information provided in the Criteria 2 Supplement for the system-specific AMPs Flow-Accelerated Corrosion Monitoring Program and Service Water System Reliability and In-Service Testing Program and has found them to be acceptable for managing the aging effects identified for these Criteria 2 systems. The staff's evaluations of these AMPs are documented in Sections 3.4.2.4.1 and 3.3.2.3.1 of this SER.

The staff has evaluated the new AMP Area Based Inspections for Refined 10 CFR 54.4(a)(2) Criteria Commodities provided in Appendix B of the supplemental submittal and has found it to be acceptable for managing the aging effects identified for these Criteria 2 systems. The staff's evaluation of this AMP is documented in Section 3.0.3.9 of this SER.

After evaluating the applicant's AMR for each of the components in the Criteria 2 systems, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects for these systems. For those components identified in Criteria 2 Supplement Table 1 that are consistent with LRA Table 3.3-1 , the staff verified that the applicant credited the AMPs recommended by the GALL report. For the components identified in Criteria 2 Supplement Table 1 that are different from or not addressed in GALL but are relied

on for license renewal, the staff verified that the applicant credited AMPs that are appropriate for the identified aging effects.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the systems, structures, and components under refined Criterion 2 will effectively manage or monitor the aging effects identified in the LRA.

3.0.5.3 Conclusion

On the basis of its review, the staff concludes that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.0.6 References

1. Letter from USNRC to SCE&G, “Request for Additional Information for the Review of the V.C. Summer Nuclear Station License Renewal Application,” dated March 28, 2003.

2. Letter from SCE&G to USNRC, “Responses to Request for Additional Information for the Review of the License Renewal Application for the Virgil C. Summer Nuclear Station,” dated June 16, 2003 (RC-03-0112).

3.1 Aging Management of Reactor Vessel, Internals, and Reactor Coolant System

This section addresses the aging management of the components of the reactor vessel, internals, and reactor coolant system. The systems that make up the reactor vessel, internals, and reactor coolant system are described in the following SER sections:

- reactor coolant system (2.3.1.1)
- piping, valves and pumps (2.3.1.2)
- reactor vessel (2.3.1.3)
- reactor vessel internals (2.3.1.4)
- incore instrumentation system (2.3.1.5)
- pressurizer (2.3.1.6)
- steam generators (2.3.1.7)

The reactor coolant system (RCS) at the VCSNS consists of three primary coolant loops interconnected at the reactor vessel. Each loop contains one reactor coolant pump (RCP), one steam generator, valves, and interconnecting piping. The pressurizer, connected to one of the hot legs, provides a means for controlling RCS pressure changes during reactor operations. The RCS also contains piping and components that allow venting of the reactor vessel and pressurizer.

The reactor coolant piping at VCSNS consists of non-Class 1 and Class 1 components. The applicant describes the system boundaries for the non-Class 1 components and Class 1 reactor coolant (RC) piping and associated components in LRA Section 2.3.1, “Reactor Vessel, Internals and Reactor Coolant System.” The non-Class 1 portions of the RCS (excluding the

RCP motor oil collection subsystem) are relied upon to provide system pressure boundary integrity. In addition, the orifices on the non-Class 1 piping are relied upon to provide throttling. The results from the AMR for the non-Class 1 portions of the RCS are described in Section 3.1, "Reactor Vessel, Internals, and Reactor Coolant System," LRA Section 3.2, "Engineered Safety Features," and LRA Section 3.3, "Auxiliary Systems," and are summarized in LRA Tables 3.1-1, 3.1-2, 3.2-1, 3.2-2, 3.3-1, and 3.3-2. The staff's evaluation of LRA Sections 3.2 and 3.3 is described, in Section 3.2 and 3.3, respectively, of this SER.

The applicant's AMR evaluations of the components in each of the seven RCS subsystems, except for several non-Class I and a few Class 1 RCS components, are provided in either LRA Table 3.1-1 or LRA 3.1-2. LRA Table 3.1-1 contains 35 items. The scope of AMR Items 18 through 35 of LRA Table 3.1-1 provides the AMR results that are consistent with GALL and for which GALL has concluded that no additional evaluation is necessary beyond that which is provided (discussed) in the AMR entry for the component in the corresponding GALL evaluation table. The staff's evaluation of LRA Table 3.1-1, Items 18 through 35 is provided in Sections 3.1.2.1 and 3.1.2.4 of this SER. The scope of AMR Items 1 through 17 of LRA Table 3.1-1 provides the AMR results that are consistent with GALL and for which the corresponding AMR analysis in the GALL evaluation table has concluded is in need of additional evaluation. The staff's evaluation of LRA Table 3.1-1, Items 1 through 17 is described in Sections 3.1.2.2 and 3.1.2.4 of this SER.

The scope of LRA Table 3.1-2 consists of the AMR results for RCS components that are different from the GALL Report, or not evaluated in the GALL Report. The applicant has determined that the materials, environment, and aging effects for components in Table 3.1-2 are similar to those in GALL and proposes to manage the aging effects with the appropriate GALL AMP. The staff's evaluation of the AMRs for these components is included in Section 3.1.2.4 of this SER. In addition, the AMR for several non-Class 1 and a few Class 1 RCS components is presented in Tables 3.2-1, 3.2-2, 3.3-1, and 3.3-2 of the LRA.

The staff's evaluations of the AMPs that are specific to the RCS at VCSNS are provided in the following subsections to Section 3.1.2.3 of this SER:

- Alloy 600 Aging Management Program (3.1.2.3.1)
- Bottom-mounted Instrumentation Inspection Program (3.1.2.3.2)
- Inservice Inspection Plan (3.1.2.3.3)
- Reactor Head Closure Studs Program (3.1.2.3.4)
- Steam Generator Management Program (3.1.2.3.5)
- Reactor Vessel Surveillance Program (3.1.2.3.6)
- Reactor Vessel Internals Inspection Program (3.1.2.3.7)
- Small Bore Class I Piping Inspection Program (3.1.2.3.8)
- Thermal Fatigue Program (3.1.2.3.9)

3.1.1 Summary of Technical Information in the Application

The description of the systems that comprise the reactor vessel, internals, and reactor coolant system can be found in LRA Sections 2.3.1 and 3.1.1. The passive, long-lived components in these systems that are subject to an AMR are identified in LRA Tables 2.3-1 to 2.3-7. The applicant described the VCSNS AMRs for the reactor vessel, internals, and reactor coolant

system in LRA Section 3.1. For several non-Class 1 RCS components, the applicant described its AMRs in LRA Sections 3.2 and 3.3.

The applicant followed the methods described in Section 4.2 of Nuclear Energy Institute (NEI) 95-10 for determining the aging effects for reactor vessel, internals, and reactor coolant system components. In addition, the applicant applied the information contained in NRC-approved industry generic topical reports for identifying the components requiring aging management and the related AMPs. NRC-approved industry generic topical reports are discussed in Section 3.1.2.1 of the LRA.

The applicant's AMRs included an evaluation of plant-specific and industry operating experience. The plant-specific evaluation included reviews of (1) the Corrective Action Program, (2) licensee event reports, (3) maintenance rule database, and (4) interviews with systems engineers to identify aging effects that require management. These reviews concluded that the aging effects requiring management, based on the VCSNS operating experience, were consistent with aging effects identified using the methods described in the preceding paragraph.

The applicant's review of industry operating experience included a review of operating experience since the effective date of NUREG-1801. No additional aging effects requiring management were identified beyond those identified using the methods described earlier in this section. The applicant's ongoing review of plant-specific and industry-wide operating experience is conducted in accordance with the VCSNS Operating Experience Program.

3.1.2 Staff Evaluation

In LRA Section 3.1, the applicant described its AMRs for the reactor vessel, internals, and reactor coolant system at VCSNS. The staff reviewed LRA Section 3.1 to determine whether the applicant had provided sufficient information to demonstrate that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB throughout the period of extended operation, in accordance with the requirements of 10 CFR 54.21(a)(3), for the reactor vessel, internals, and reactor coolant system components that are determined to be within the scope of license renewal and subject to an AMR.

The applicant referenced the GALL Report in its AMR. The staff has previously evaluated the adequacy of the aging management of reactor system components for license renewal, as documented in the GALL Report. Thus, the staff did not repeat its review of the matters described in the GALL Report, except to ensure that the material presented in the LRA was applicable, and to verify that the applicant had identified the appropriate programs as described and evaluated in the GALL Report. The staff evaluated those aging management issues recommended for further evaluation in the GALL Report. The staff also reviewed aging management information submitted by the applicant that was different from that in the GALL Report or was not addressed in the GALL Report. Finally, the staff reviewed the FSAR Supplement to ensure that it provided an adequate description of the programs credited with managing aging for the reactor system components.

In LRA Section 3.1, the applicant provided brief descriptions of the reactor systems and summarized the results of its AMR of the reactor systems at VCSNS.

Table 3.1-1, below, provides a summary of the staff's evaluation of the aging effects and AMPs for the components of the RCS subsystems that are discussed in LRA Section 3.1, evaluated by the applicant in Table 3.1-1 of the LRA, and addressed by the staff in the GALL Report.

Table 3.1-1 Staff Evaluation Table for Reactor System Components in the GALL Report

Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
Reactor coolant pressure boundary components	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	10 CFR 54.21(c)(1)(i) Analyses remain valid	Consistent with GALL which recommends further evaluation. (See Section 3.1.2.2.1, below.)
Steam generator shell assembly	Loss of material due to pitting and crevice corrosion	Inservice inspection; water chemistry	Chemistry Program (Appendix B.1.4); ISI Plan (Appendix B.1.7)	Consistent with GALL, which recommends further evaluation. (See Section 3.1.2.2.2, below.)
Pressure vessel ferritic materials that have a neutron fluence greater than 10^{17} n/cm^2 (E>1 MeV)	Loss of fracture toughness due to neutron irradiation embrittlement	TLAA, evaluated in accordance with Appendix G of 10 CFR 50 and RG 1.99		Consistent with GALL, which recommends further evaluation. (See Section 3.1.2.2.3, below.)
Reactor vessel beltline shell and welds	Loss of fracture toughness due to neutron irradiation embrittlement	Reactor vessel surveillance	Reactor Vessel Surveillance Program (Appendix B.1.24)	Consistent with GALL, which recommends further evaluation. (See Section 3.1.2.2.4, below.)
Westinghouse and B&W baffle/former bolts	Loss of fracture toughness due to neutron irradiation embrittlement and void swelling	Plant-specific	Reactor Vessel Internals Inspection Program (Appendix B.2.4)	Consistent with GALL, which recommends further evaluation. (See Section 3.1.2.2.5, below)
Small bore reactor coolant system and connected systems piping	Crack initiation and growth due to SCC, IGSCC, and thermal and mechanical loading	Inservice inspection; water chemistry; one-time inspection	Small Bore Class 1 Piping Inspection Program (Appendix B.2.7); the Chemistry Program (Appendix B.1.4); and ISI Plan (Appendix B.1.7)	Consistent with GALL, which recommends further evaluation. (See Section 3.1.2.2.6, below.)
Vessel shell	Crack growth due to cyclic loading	TLAA		Consistent with GALL, which recommends further evaluation. (See Section 3.1.2.2.7, below.)
Reactor internals	Changes in dimension due to void swelling	Plant-specific	Reactor Vessel Internals Inspection Program (Appendix B.2.4)	Consistent with GALL, which recommends further evaluation. (See Section 3.1.2.2.8, below.)

Table 3.1-1 Staff Evaluation Table for Reactor System Components in the GALL Report				
Component Group	**Aging Effect/ Mechanism**	**AMP in GALL Report**	**AMP in LRA**	**Staff Evaluation**
PWR core support pads, instrument tubes (bottom head penetrations), pressurizer spray heads, and nozzles for the steam generator instruments and drains	Crack initiation and growth due to SCC and/or PWSCC	Plant-specific	Alloy 600 Aging Management Program which includes the (Appendix B.1.1); Chemistry Program (Appendix B.1.4); and ISI Plan (Appendix B.1.7)	Consistent with GALL, which recommends further evaluation. (See Section 3.1.2.2.9, below.)
Cast austenitic stainless steel (CASS) in reactor coolant system piping	Crack initiation and growth due to SCC	Plant-specific	Chemistry program (Appendix B.1.4) and in-service inspection plan (Appendix B.1.7)	Consistent with GALL, which recommends further evaluation (See Section 3.1.2.2.10, below)
Pressurizer instrumentation penetrations and heater sheaths and sleeves made of Nickel alloys	Crack initiation and growth due to PWSCC	Inservice inspection; water chemistry	Alloy 600 aging management program which includes the Water Chemistry Program (Appendix B.1.1)	Consistent with GALL, which recommends further evaluation. (See Section 3.1.2.2.11, below.)
Westinghouse and B&W baffle former bolts	Crack initiation and growth due to SCC and IASCC	Plant-specific	Reactor Vessel Internals Inspection Program (Appendix B.2.4); Chemistry program (Appendix B.1.4)	Consistent with GALL, which recommends further evaluation. (See Section 3.1.2.2.12, below)
Westinghouse and B&W baffle former bolts	Loss of preload due to stress relaxation	Plant-specific	Reactor Vessel Internals Inspection Program (Appendix B.2.4)	Consistent with GALL, which recommends further evaluation. (See Section 3.1.2.2.13, below.)
Steam generator feedwater impingement plate and support	Loss of section thickness due to erosion	Plant-specific	Applicant states that these components do not have license renewal function for VCSNS	Consistent with GALL, which recommends further evaluation. (See Section 3.1.2.2.14, below.)
(Alloy 600) Steam generator tubes, repair sleeves, and plugs	Crack initiation and growth due to PWSCC, ODSCC, and/or IGA or loss of material due to wastage and pitting corrosion and fretting and wear, or deformation due to corrosion at tube support plate intersections	Steam generator tubing integrity; water chemistry	Chemistry Program (Appendix B.1.4); Steam Generator Management Program (Appendix B.1.10)	Consistent with GALL, which recommends further evaluation. (See Section 3.1.2.2.15, below.)

Table 3.1-1 Staff Evaluation Table for Reactor System Components in the GALL Report				
Component Group	**Aging Effect/ Mechanism**	**AMP in GALL Report**	**AMP in LRA**	**Staff Evaluation**
Tube support lattice bars made of carbon steel	Loss of section thickness due to FAC	Plant-specific	None	This is not an applicable aging effect because it applies only to Combustion Engineering steam generators.
Carbon steel tube support plate	Ligament cracking due to corrosion	Plant-specific	None	This is not an applicable aging effect because the VCSNS tube support plates are made of Type 405 stainless steel, not carbon steel.
Steam generator feedwater inlet ring and supports	Loss of material due to FAC	Combustion engineering (CE) steam generator feedwater ring inspection	None	This is not an applicable aging effect because it applies only to Combustion Engineering steam generators.
Reactor vessel closure studs and stud assembly	Crack initiation and growth due to SCC and/or IGSCC	Reactor head closure studs	Reactor Head Closure Studs Program (Appendix B.1.8)	Consistent with GALL, which recommends no further evaluation. (See Section 3.1.2.1, below)
CASS pump casing and valve body	Loss of fracture toughness due to thermal aging embrittlement	Inservice inspection	Inservice Inspection Plan (Appendix B.1.7)	Consistent with GALL, which recommends no further evaluation. (See Section 3.1.2.1, below.)
CASS piping and fittings	Loss of fracture toughness due to thermal aging embrittlement	Thermal aging embrittlement of CASS	None (See Section 3.1.2.4.2 of this SER for discussion.)	Consistent with GALL, which recommends no further evaluation. (See Section 3.1.2.4.2, below.)
PWR piping and fittings; and steam generator components	Wall thinning due to FAC	Flow-accelerated corrosion	None (See Section 3.1.2.4.7 of this SER for discussion.)	VCSNS has not identified wall thinning due to FAC as an applicable aging effect for its steam generator components (See Section 3.1.2.4.7, below.)
Reactor coolant pressure boundary (RCPB) valve closure bolting, manway and holding bolting, and closure bolting in high pressure and high temperature systems	Loss of material due to wear, loss of preload due to stress relaxation, crack initiation and growth due to cyclic loading and/or SCC	Bolting integrity	Inservice Inspection Plan (Appendix B.1.7) A discussion of the applicability of the ISI program for bolting is provided in SER Section 3.1.2.3.3.)	Consistent with GALL, which recommends no further evaluation. (See Section 3.1.2.1, below). Loss of material due to wear for the CRD flange bolting is further discussed in SER Section 3.1.2.4.3

Table 3.1-1 Staff Evaluation Table for Reactor System Components in the GALL Report				
Component Group	**Aging Effect/ Mechanism**	**AMP in GALL Report**	**AMP in LRA**	**Staff Evaluation**
CRD nozzle	Crack initiation and growth due to PWSCC	Nickel alloy nozzles and penetrations; water chemistry	Alloy 600 Aging Management Program which includes water chemistry program (Appendix B.1.1)	Consistent with GALL, which recommends no further evaluation. (See Section 3.1.2.1, below.)
Reactor vessel nozzles safe ends and CRD housing and reactor coolant system components (except CASS and bolting)	Crack initiation and growth due to cyclic loading, and/or SCC, and PWSCC	Inservice inspection; water chemistry	Chemistry Program (Appendix B.1.4); ISI Plan (Appendix B.1.7); Alloy 600 AMP (Appendix B.1.1)	Consistent with GALL, which recommends no further evaluation. (See Section 3.1.2.1, below.)
Reactor vessel internals CASS components	Loss of fracture toughness due to thermal aging, neutron irradiation embrittlement, and void swelling	Thermal aging and neutron irradiation embrittlement	None	VCSNS does not have any CASS internals that are within the scope of license renewal.
External surfaces of carbon steel components in reactor coolant system pressure boundary	Loss of material due to boric acid corrosion	Boric acid corrosion	Boric Acid Corrosion Surveillances Program (Appendix B.1.2)	Consistent with GALL, which recommends no further evaluation. (See Section 3.1.2.1, below.)
Steam generator secondary manways and handholds	Loss of material due to erosion	Inservice inspection	None	Applies only to B&W steam generators. VCSNS has Westinghouse steam generators.
Reactor internals, reactor vessel closure studs, and core support pads	Loss of material due to wear	Inservice inspection	Reactor Vessel Internals Inspection Program (Appendix b.2.4); Inservice Inspection Plan (Appendix B.1.7); Bottom-mounted Instrumentation Inspection Program (Appendix B.1.3)	Consistent with GALL, which recommends no further evaluation. (See Section 3.1.2.1, below.)
Pressurizer integral support	Crack initiation and growth due to cyclic loading	Inservice inspection	Inservice Inspection Plan (Appendix B.1.7)	Consistent with GALL, which recommends no further evaluation. (See Section 3.1.2.1, below.)
Upper and lower internals assembly (Westinghouse)	Loss of preload due to stress relaxation	Inservice inspection; loose part and/or neutron noise monitoring	Reactor Vessel Internals Inspection Program (Appendix B.2.4) which includes a VT-3 inspection in lieu of the loose parts monitoring program	Consistent with GALL, except for the loose parts monitoring program. GALL recommends no further evaluation. (See Sections 3.1.2.1 and 3.1.2.3.6, below.)

Table 3.1-1 Staff Evaluation Table for Reactor System Components in the GALL Report				
Component Group	**Aging Effect/ Mechanism**	**AMP in GALL Report**	**AMP in LRA**	**Staff Evaluation**
Reactor vessel internals in fuel zone region (except Westinghouse and B&W baffle bolts)	Loss of fracture toughness due to neutron irradiation embrittlement and void swelling	PWR vessel internals	Reactor Vessel Internals Inspection Program which includes water chemistry (Appendix B.2.4)	Consistent with GALL, which recommends no further evaluation. (See Section 3.1.2.1, below.)
Steam generator upper and lower heads; tubesheets; primary nozzles and safe ends	Crack initiation and growth due to SCC, PWSCC. IASCC	Inservice inspection; water chemistry	Chemistry program (Appendix B.1.4); Inservice Inspection Plan (Appendix B.1.7), and Alloy 600 aging management plan (Appendix B.1.1)	Consistent with GALL, which recommends no further evaluation. (See Section 3.1.2.1, below.)
Vessel internals (except Westinghouse and B&W baffle former bolts)	Crack initiation and growth due to SCC and IASCC	PWR vessel internals; water chemistry	Reactor Vessel Internals Inspection Program (Appendix B.2.4); Chemistry Program (Appendix B.1.4)	Consistent with GALL, which recommends no further evaluation. (See Section 3.1.2.1, below.)
Reactor internals (B&W screws and bolts)	Loss of preload due to stress relaxation	Inservice inspection; loose part monitoring		Applies only to B&W Plant. VCSNS is a Westinghouse plant.
Reactor vessel closure studs and stud assembly	Loss of material due to wear	Reactor head closure studs	Reactor Head Closure Studs Program (Appendix B.1.8)	Consistent with GALL, which recommends no further evaluation. (See Section 3.1.2.1, below.)
Reactor internals (Westinghouse upper and lower internal assemblies; CE bolts and tie rods)	Loss of preload due to stress relaxation	Inservice inspection; loose parts monitoring	Reactor Vessel Internals Inspection Program (Appendix B.2.4) which includes a VT-3 inspection in lieu of the loose parts monitoring program.	Consistent with GALL, with the exception of the loose parts monitoring program; GALL recommends no further evaluation. (See Sections 3.1.2.1 and 3.1.2.3.6 below.)

3.1.2.1 Aging Management Evaluations in the GALL Report that are Relied on for License Renewal, that Do Not Require Further Evaluation

For component groups evaluated in GALL for which the applicant has claimed consistency with GALL, and for which GALL does not recommend further evaluation, the staff sampled components in these groups to determine whether the plant-specific components contained in these GALL component groups were bounded by the GALL evaluation. The staff also sampled component groups to determine whether the applicant had properly identified those component groups in GALL that were not applicable to its plant. The staff also identified several areas where additional information or clarification was needed. The staff's evaluation of applicants responses to those RAIs is included in Section 3.1.2.4 of this SER.

On the basis of its review of the inspection results, the staff verified the applicant's claim of consistency with the GALL report. The staff finds that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended

functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.2 Aging Management Evaluations in the Gall Report That Are Relied on for License Renewal, for Which Gall Recommends Further Evaluation

For component groups evaluated in GALL for which the applicant has claimed consistency with GALL, and for which GALL recommends further evaluation, the staff reviewed the applicant's evaluation to determine whether it adequately addressed the issues for which GALL recommended further evaluation. In addition, the staff sampled components in these groups to determine whether the plant-specific components contained in these GALL component groups were bounded by the GALL evaluation.

The GALL Report indicates that further evaluation should be performed for the aging effects discussed in the following sections.

3.1.2.2.1 Cumulative Fatigue Damage

Fatigue is a time-limited aging analysis (TLAA) as defined in 10 CFR 54.3. The staff's evaluation of this TLAA is provided in Section 4.3 of this SER.

3.1.2.2.2 Loss of Material Due to Pitting and Crevice Corrosion

The SRP-LR (NUREG-1800) identifies loss of material due to pitting and crevice corrosion as an aging effect that could occur in the low-alloy steel SG shell assembly. The GALL Report recommends further evaluation of the effectiveness of the applicant's AMP to ensure that this aging effect is adequately managed. To manage this aging effect, the GALL Report identifies the appropriate AMP as GALL AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD" and GALL AMP XI.M2, "Water Chemistry" for pressurized water reactor (PWR) secondary water. The GALL Report also cites NRC Information Notice (IN) 90-04, "Cracking of the Upper Shell-to-Transition Cone Girth Welds in Steam Generators," which describes weld-zone cracking observed in the field that initiated at surface corrosion pits. IN 90-04 states that if general corrosion pitting of the SG shell is known to exist, the requirements of ASME Section XI may not be sufficient to differentiate isolated cracks from inherent geometric conditions. IN 90-04 recommends enhanced UT procedures and the additional use of visual and magnetic particle testing (MT), as necessary, to detect surface-connected flaws.

The applicant addressed this aging effect in LRA Table 3.1-1, AMR Item 2. In its discussion, the applicant stated that IN 90-04 contains only a general indication that surface pits serve as crack initiation sites and does not indicate that pitting corrosion results in sufficient degradation to cause loss of component function. The applicant further stated that no subsequent industry experience has further identified pitting corrosion resulting in reportable indications for the SG shell. The applicant indicated that cracking in the SG shell caused by flaw growth is managed by its Inservice Inspection Plan (ISI) and general, pitting, and crevice corrosion are managed by its Chemistry Program.

The applicant stated that its ISI Plan is consistent with GALL AMP XI.M1, which, in turn, is based upon ASME Section XI, "Rules for Inservice Inspection of Nuclear Power Plant

Components,” Subsections IWB, IWC, and IWD. However, GALL AMP XI.M1 states, “in certain cases, the ASME Inservice Inspection Plan is to be augmented to manage effects of aging for license renewal ....”

In RAI 3.1.2.2.2-1, the staff requested the applicant to provide an enhanced condition monitoring program that can reliably detect pitting and crevice corrosion at the inside surface of the SG girth welds so that loss of material is effectively managed. In its response to RAI 3.1.2.2.2-1, dated June 12, 2003, the applicant stated that an enhanced condition monitoring program is not needed because (1) pitting corrosion reported in IN 90-04 did not result in sufficient degradation to cause loss of component intended function, and (2) no subsequent industry experience has further identified pitting corrosion resulting in reportable indications for the SG shell.

The staff found the applicant’s response insufficient because the volumetric examination of the shell welds, as required by ASME Section XI, is designed for detecting cracking and not pits. In a discussion with the applicant on June 22, 2003, the staff requested that the applicant perform a one-time inspection before entering into license renewal operation to verify whether loss of material due to pitting and crevice corrosion is present on the inside surface of the SG shell. If present, the applicant would need to provide an enhanced inspection plan to monitor loss of material due to pitting corrosion and ensure that the component intended function will be maintained during the extended period. In its additional response to RAI 3.1.2.2.2-1, in a letter dated September 2, 2003, the applicant stated that each steam generator secondary-side inspection does include a visual inspection of the accessible portions of the shell. The applicant performs steam generator secondary-side inspections periodically. If loss of material due to pitting corrosion is found in the inside surface of the SG shell, the applicant will take corrective actions to mitigate and control the corrosion problem under its Steam Generator Management Program as discussed in LRA B.1.10. The staff finds the applicant’s response to RAI 3.1.2.2.2-1 acceptable. The staff’s review of the Steam Generator Management Program is discussed in Section 3.1.2.3.5 of this safety evaluation.

On the basis of its review, the staff finds that the applicant has appropriately evaluated AMR results involving management of loss of material due to crevice and pitting corrosion for the steam generator shell assembly, as recommended in the GALL report. Since the applicant’s AMR results are otherwise consistent with the GALL report, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained by 10 CFR 54.21(a)(3).

3.1.2.2.3 Loss of Fracture Toughness due to Neutron Irradiation Embrittlement (TLAA)

Certain aspects of neutron irradiation embrittlement are TLAAs as defined in 10 CFR 54.3. The staff’s evaluation of these TLAAs are provided in Section 4.2 of this SER.

3.1.2.2.4 Loss of Fracture Toughness due to Neutron Irradiation Embrittlement

Loss of fracture toughness due to neutron irradiation embrittlement could occur in the reactor vessel. The Reactor Vessel Surveillance Program monitors neutron irradiation embrittlement of the reactor vessel. Reactor Vessel Surveillance Programs are plant-specific, depending on matters such as the composition of limiting materials, availability of surveillance capsules, and projected fluence levels. In accordance with 10 CFR Part 50, Appendix H, an applicant is

required to submit its proposed withdrawal schedule for approval prior to implementation. Thus, further staff evaluation is required for license renewal. The GALL Report recommends further evaluation of the Reactor Vessel Surveillance Program for the period of extended operation. The staff verifies that the applicant has proposed an adequate Reactor Vessel Surveillance Program for the period of extended operation.

VCSNS has an existing Reactor Vessel Surveillance Program, described in LRA Section B.1.24, for managing loss of fracture toughness in reactor vessel beltline shell and welds due to neutron irradiation embrittlement. This program is consistent with GALL AMP XI.M31, Reactor Vessel Surveillance Program. The evaluation of this existing program is presented in Section 3.1.2.3.6 of this SER. The applicant stated that the VCSNS Reactor Vessel Surveillance Program will manage radiation embrittlement by addressing the most limiting subcomponents with respect to exposure to the greatest fluence postulated to occur during the period of extended operation. The applicant concluded that upper shell and nozzles are not limiting components for neutron irradiation embrittlement due to their physical distance from the active fuel assembly. This is further evaluated in Section 3.1.2.3.6 of this SER.

On the basis of its review, the staff finds that the applicant has appropriately evaluated AMR results involving management of the loss of fracture toughness due to neutron irradiation embrittlement for components in the reactor systems, as recommended in the GALL report. Since the applicant's AMR results are otherwise consistent with the GALL report, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.2.5 Loss of Fracture Toughness Due to Neutron Irradiation Embrittlement and Void Swelling

Loss of fracture toughness due to neutron irradiation embrittlement and void swelling could occur in Westinghouse and Babcock & Wilcox (B&W) baffle/former assembly bolts. The GALL Report states that the applicant is to provide a plant-specific AMP to manage this potential aging effect. Acceptance criteria are described in BTP RLSB-1 (Appendix A of the SRP-LR). The staff has reviewed the applicant's proposed program to ensure that an adequate program is in place to manage these aging effects.

VCSNS has instituted a new program, the Reactor Vessel Internals Inspection program (LRA B.2.4), to manage loss of fracture toughness in the baffle/former assembly bolts. The loss of fracture toughness has significant consequences only if cracks are present in the bolts. Therefore, the program manages loss of fracture toughness by inspecting for cracking. The program relies on the use of visual and volumetric examination techniques to detect cracking. For accessible components, a visual inspection will be performed to detect the presence and extent of cracking. For inaccessible locations, such as a juncture of baffle/former bolt head and shank, a volumetric inspection will be performed to detect cracking. According to the acceptance criteria for bolts, any detectable crack indication is unacceptable for a particular bolt. This program assumes sufficient redundancy in bolt functions so that the plant can continue to function safely with fewer than 100 percent of the bolts intact. The staff finds that this approach is consistent with the one described in NUREG-1801, Section XI.M16, "PWR Vessel Internals." The evaluation of this new program is presented in Section 3.1.2.3.7 of this SER.

On the basis of its review, the staff finds that the applicant has appropriately evaluated AMR results involving management of loss of fracture toughness for the baffle and former bolts, as recommended in the GALL report. Since the applicant's AMR results are otherwise consistent with the GALL report, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.2.6 Crack Initiation and Growth Due to Stress-Corrosion Cracking, Intergranular Stress Corrosion Cracking, and Thermal and Mechanical Loading

Crack initiation and growth due to thermal and mechanical loading or SCC (including intergranular stress corrosion cracking [IGSCC]) could occur in smallbore reactor coolant system and connected system piping less than normal pipe size (NPS) 4. The existing program relies on ASME Section XI Inservice inspection and on the control of water chemistry to mitigate SCC. The GALL Report recommends that a plant-specific destructive examination or a nondestructive examination (NDE) that permits inspection of the inside surfaces of the piping be conducted to ensure that cracking has not occurred and that the component intended function will be maintained during the extended period. The AMPs should be augmented for verifying that service-induced weld cracking is not occurring in the smallbore piping less than NPS 4, including pipe, fittings, and branch connections. A one-time inspection of a sample of locations is an acceptable method to ensure that the aging effect is not occurring and that the component intended function will be maintained during the period of extended operation. GALL AMP XI.M32, "One-Time Inspection" contains an acceptable verification method.

The GALL Report recommends that the inspection include a representative sample of the system population, and, where practical and prudent, focus on the bounding or lead components most susceptible to aging due to time in service, severity of operating conditions, and lowest design margin. For smallbore piping, actual inspection locations should be based on physical accessibility, exposure levels, NDE examination techniques, and locations identified in IN 97-46, "Unisolable Crack in High-Pressure Injection Piping." Combinations of NDE, including visual, ultrasonic, and surface techniques, are performed by qualified personnel following procedures consistent with the ASME Code and 10 CFR Part 50, Appendix B. For smallbore piping less than NPS 4, including pipe, fittings, and branch connections, a plant-specific destructive examination or NDE that permits inspection of the inside surfaces of the piping should be conducted to ensure that cracking has not occurred. Follow up of unacceptable inspection findings should include expansion of the inspection sample size and locations. The inspection and test techniques prescribed by the program should verify the existence of any aging effects because these techniques, used by qualified personnel, have been proven effective and consistent with staff expectations.

The staff's review confirms that the program includes measures to verify that unacceptable degradation is not occurring, thereby validating the effectiveness of existing programs, or confirming that there is no need to manage aging-related degradation for the period of extended operation. If an applicant proposes a one-time inspection of selected components and susceptible locations to ensure that cracking is not occurring, the reviewer verifies that the proposed inspection will be performed using techniques consistent with ASME Code and American Society for Testing and Materials (ASTM) standards, including visual, ultrasonic, and

surface techniques, to ensure that the component intended function will be maintained during the period of extended operation.

The applicant has proposed a new program, “Small Bore Class 1 Piping Inspections,” along with two existing programs, the Chemistry Program and Inservice Inspection Plan, to manage cracking on the inside surface of the small bore Class 1 piping. This group of programs is consistent with the group of programs recommended by GALL. The new program is consistent with GALL AMP XI.M32. The evaluation of the new program is presented in Section 3.1.2.3.8 of this SER. Since the current volumetric examination methods are not reliable for detecting flaws at the inside surface of the small diameter piping, the applicant proposes a use of destructive testing of selected samples of the piping for more reliable inspection. The program will identify the locations most susceptible to cracking based on engineering evaluation, operating experience, current code requirements, and industry initiatives. Actual inspection locations will be selected based on physical accessibility, exposure levels, and scheduling requirements. The applicant further stated that the inspection locations will be selected by engineering judgment, using risk-based approaches. The applicant has identified the information sources that will be used in identifying the susceptible locations and in selecting the sample locations for inspections. In response to an RAI asking the applicant whether it will follow the EPRI-sponsored industry activities and whether the inspection locations would be the bounding locations, the applicant stated that VCSNS intends to follow and implement the recommendations of industry initiatives by the EPRI sponsored Materials Reliability Program (MRP) Industry Task Group (ITG) on Thermal Fatigue on small bore piping. The applicant further stated that the locations selected for inspection would be representative of the bounding locations. The staff finds this response acceptable because implementation of the recommendations of the EPRI-sponsored program, which is the main industry activity related to smallbore piping, and inspection of bounding locations would provide assurance that the smallbore piping will be safely operated during the extended period of operation.

On the basis of its review, the staff finds that the applicant has appropriately evaluated AMR results involving management of crack initiation and growth due to thermal and mechanical loading or stress corrosion cracking for small-bore reactor coolant system and connected system piping, as recommended in the GALL report. Since the applicant’s AMR results are otherwise consistent with the GALL report, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.2.7 Crack Growth Due to Cyclic Loading

Crack growth due to cyclic loading could occur in the reactor vessel shell. Growth of intergranular separations (underclad cracks) in low-alloy or carbon steel heat-affected zones under austenitic stainless steel cladding is a TLAA that is to be evaluated for the period of extended operation for all the SA 508-Cl 2 forgings where the cladding was deposited using high heat input welding process. The methodology for evaluating underclad flaws should be consistent with the current well established flaw evaluation procedures and criterion in the ASME Section XI Code. Section 4.7, “Other Plant-Specific Time-Limited Aging Analysis,” of the SRP-LR provides generic guidance for meeting the requirements of 10 CFR 54.21(c). The GALL Report recommends further evaluation of programs to manage crack growth due to cyclic loading in the reactor vessel shell and reactor coolant system piping and fittings.

In LRA Table 3.1-1, AMR Item 7, the applicant stated that the VCSNS vessel is constructed of ASME SA 533 Grade B, Cl 1 plate material and not ASME SA 508 Cl 2 forgings. Therefore, the aging effect of growth of underclad cracking is not applicable to the VCSNS vessel. However, Table 5.2-8 of the VCSNS UFSAR identifies SA 508 Cl 2 as one of the materials for reactor vessel shell, flange, and nozzle forgings and nozzle safe ends. In response to RAI 3.1.2.2.7-1, the applicant clarified this discrepancy by stating that the reactor vessel shell (upper, intermediate, and lower shell including beltline welds) is not made of ASME SA 508, Cl 2 material. Therefore, crack growth due to cyclic loading is not an applicable aging effect for the reactor vessel shell. The applicant further stated that the vessel flange and nozzle forgings are made of ASME SA 508, Cl 2 material; however, a high heat input welding process was not utilized on the cladding. Therefore, the staff agreed that underclad cracking is not an applicable aging effect for these forgings because the high heat input welding processes affecting underclad cracking (i.e., strip clad and manual inert gas cladding processes) were not used to apply cladding to these components.

On the basis of its review, the staff finds that the applicant has appropriately evaluated AMR results involving management of crack growth due to cyclic loading for components in the reactor systems, as recommended in the GALL report. Since the applicant's AMR results are otherwise consistent with the GALL report, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.2.8 Changes in Dimension Due to Void Swelling

Changes in dimension due to void swelling could occur in the PWR reactor internals. The GALL Report states that the applicant is to provide a plant-specific AMP or participate in industry programs to investigate aging effects and determine an appropriate AMP. Otherwise, the applicant is to provide the basis for concluding that void swelling is not an issue for the component. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of the SRP-LR). The staff has reviewed the applicant's proposed program to ensure that an adequate program is in place to manage these aging effects.

VCSNS has instituted a new program, the Reactor Vessel Internals Inspection Program (LRA B.2.4), to manage changes in dimension due to void swelling, which could occur in the PWR reactor vessel internals. This new program is consistent with GALL AMP XI.M16, "PWR Vessel Internals." The evaluation of this program is provided in Section 3.1.2.3.7 of this SER. The program relies on the use of visual and volumetric examination techniques to detect changes in dimensions. For accessible components, enhanced visual inspections will be performed to detect the presence and extent of changes in dimensions. For bolts and other inaccessible components, a volumetric inspection will be performed to detect the presence and extent of changes in dimensions due to irradiation creep and void swelling. The applicant further noted that, with respect to changes in dimensions due to void swelling, industry activities are underway to determine whether this is an aging effect requiring management for license renewal, and, if necessary, to develop and qualify methods for detection and management. The applicant will continue to monitor these activities and implement the resulting methods, as necessary. The applicant stated that specific acceptance criteria for changes in dimension due to void swelling will be determined by analysis as part of the inspection plan. The staff finds the applicant's approach for managing changes in dimension due to void swelling acceptable

because the approach will be based on the guidelines developed by the ongoing industry activities related to void swelling. VCSNS will develop and implement reactor vessel internal inspection program prior to the period of extended operation and will implement aging management activities that are acceptable to the staff. The applicant has agreed that this is a licensee commitment and this commitment is documented in Appendix A of the SER.

On the basis of its review, the staff finds that the applicant has appropriately evaluated AMR results involving management of changes in dimension due to void swelling for the baffle and former plates, as recommended in the GALL report. Since the applicant's AMR results are otherwise consistent with the GALL report, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.2.9 Crack Initiation and Growth Due to Stress Corrosion Cracking and/or Primary Water Stress-Corrosion Cracking

Crack initiation and growth due to SCC and primary water stress-corrosion cracking (PWSCC) could occur in PWR core support pads (or core guide lugs), instrument tubes (bottom head penetrations), pressurizer spray heads, and nozzles for the SG instruments and drains. The GALL Report recommends further evaluation to ensure that these aging effects are adequately managed. The GALL Report recommends that a plant-specific AMP be evaluated because existing programs may not be capable of mitigating or detecting crack initiation and growth due to SCC. Acceptance criteria are described in BTP RLSB-1 (Appendix of the SRP-LR). The staff reviewed the applicant's proposed program to ensure that an adequate program will be in place for the management of these aging effects.

In LRA Table 3.1-1, AMR Item 9, the applicant includes two Nickel alloy components, core support pads, and bottom head penetrations. The applicant credits (1) the Alloy 600 AMP (LRA Appendix B.1.1), (2) the Chemistry Program (LRA Appendix B.1.4) and, (3) the ISI Plan (LRA Appendix B.1.7) to manage crack initiation and growth due to PWSCC of these components. In LRA Appendix B.1.1, the applicant stated that the Alloy 600 AMP is consistent with GALL AMP XI.M11. However, according to Table 3.1-1 of NUREG-1800, the GALL AMP XI.M11 is credited for managing cracking only in control rod drive (CRD) nozzles (i.e., vessel head penetrations) and no other nickel alloy components. The staff issued RAI 3.1.2.2.9-1 requesting the applicant to clarify this discrepancy. In response to RAI 3.1.2.2.9-1, in a letter dated June 12, 2003, the applicant stated that the Alloy 600 AMP at VCSNS includes, in addition to the vessel head penetrations, the other Alloy 600 components. The staff finds this clarification about the scope of the program acceptable. However, it was not clear to the staff whether all Alloy 82/182 welds are within the scope of the program. The staff raised this question during a June 22, 2003, conference call. In response, the applicant stated that aging management of ASME Class 1 dissimilar welds (Alloy 82/182 welds) is within the scope of LRA Appendix B.1.1, the Alloy 600 AMP. The staff finds the response acceptable because it is consistent with the corresponding AMR results presented in LRA Tables 3.1-1 and 3.1-2. The additional components and weld locations that are within the scope of the Alloy 600 AMP are listed in Section 3.1.2.3.1 of this SER.

The ISI Plan specifies ASME Section XI VT-3 examination to detect cracking of the core support pads. However, the staff does not believe that the VT-3 examinations are sufficient. The applicant needs to describe an AMP for managing cracking in core support pads and

bottom head penetrations during the extended period of operation. Specifically, the applicant was requested to submit the following information: (1) the inspection method used in detecting cracking in these components, (2) the technical basis showing adequacy of this method to detect cracking, (3) the inspection frequency and its justification, and (4) the acceptance criteria. In response, the applicant stated that it will follow industry initiatives applicable to inspection of cracking of core support pads and will have an inspection program in place prior to the period of extended operation. The staff finds the applicant's response acceptable because the recommendations of the industry initiatives will be reviewed and approved by the staff.

The GALL Report includes AMR of the pressurizer spray head. However, the applicant has not presented AMR for the pressurizer spray head. This is acceptable because, according to a Westinghouse report, "License Renewal Evaluation: Aging Management Evaluation for Pressurizers," Westinghouse Commercial Atomic Power (WCAP) 14574-A, December 2000, the spray head is not within the scope of license renewal. The NRC staff has accepted this position.

On the basis of its review, the staff finds that the applicant has appropriately evaluated AMR results involving management of crack initiation and growth due to stress corrosion cracking or primary water stress corrosion cracking in PWR core support pads (or core guide lugs), instrument tubes (bottom head penetrations), pressurizer spray heads, and nozzles for the steam generator instruments and drains, as recommended in the GALL report. Since the applicant's AMR results are otherwise consistent with the GALL report, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.2.10 Crack Initiation and Growth Due to Stress Corrosion Cracking

Crack initiation and growth due to SCC could occur in PWR cast austenitic stainless steel (CASS) reactor coolant system piping and fittings and the pressurizer surge line. The GALL Report recommends further evaluation of the program for managing this aging effect. According to the GALL Report, the program is to include (1) adequate inspection methods to ensure detection of cracks, and (2) flaw evaluation methodology for CASS components that are susceptible to thermal aging management. The staff reviewed the applicant's proposed program to ensure that an adequate program will be in place for the management of these aging effects.

VCSNS has an existing program for managing crack initiation and growth due to SCC, which could occur in the PWR CASS reactor coolant system piping. The program relies on control of chemistry to mitigate crack initiation and growth and an ISI Plan to detect and size cracks. The VCSNS chemistry program is consistent with the GALL AMP XI.M2, "Water Chemistry." The ISI plan is consistent with GALL program XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, IWD," except that it is committed to an earlier edition of the ASME Code, Section XI. The GALL program refers to the 1995 Edition through the 1996 Addenda, whereas the VCSNS ISI Plan is committed to the 1989 Edition of ASME Section XI with no addenda for the second 10-year inspection interval. VCSNS has, however, adopted the 1995 Edition with 1996 addenda for ultrasonic inspection. The staff finds that the VCSNS Chemistry

Program and ISI Plan are adequate for managing cracking due to SCC in VCSNS CASS RCS piping and fittings.

On the basis of its review, the staff finds that the applicant has appropriately evaluated AMR results involving management of crack initiation and growth due to stress corrosion cracking of the CASS reactor coolant system piping and fittings, as recommended in the GALL report. Since the applicant's AMR results are otherwise consistent with the GALL report, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.2.11 Crack Initiation and Growth Due to Primary Water Stress-Crossion Cracking

Crack initiation and growth due to PWSCC could occur in PWR pressurizer instrumentation penetrations and heater sheaths and sleeves made of Nickel alloys. The existing program relies on the ASME Section XI ISI program and on the control of water chemistry to mitigate PWSCC. However, the existing program should be augmented to manage the effects of SCC on the intended function of Nickel alloy components. The GALL Report recommends that the applicant provide a plant-specific AMP or participate in industry programs to determine an appropriate AMP for PWSCC of Inconel 182 welds. Acceptance criteria are described in BTP RLSB-1 (Appendix of the SRP-LR). The staff reviewed the applicant's proposed program to ensure that an adequate program will be in place for the management of these aging effects.

According to WCAP 14574-A, "License Renewal Evaluation: Aging Management Evaluation for Pressurizers," the pressurizer instrumentation penetrations and immersion heater well assemblies, including both heater sleeves and heater sheaths in Westinghouse-designed plants, are made of austenitic stainless steel and, therefore, are not susceptible to PWSCC. These components are welded to stainless steel cladding with Alloy 82/182 welds, which are susceptible to PWSCC. Therefore, the applicant presented the AMR results for these welds, but not for the base metal of these components. The applicant credited the Alloy 600 AMP (LRA Section B.1.1), which is a condition monitoring program, for managing cracking of these welds due to PWSCC. The evaluation of this program is provided in Section 3.1.2.3.1 of the SER.

On the basis of its review, the staff finds that the applicant has appropriately evaluated AMR results involving management of crack initiation and growth due to stress corrosion cracking or primary water stress corrosion cracking in PWR pressurizer instrumentation penetrations, and heater sleeves and sheaths, as recommended in the GALL report. Since the applicant's AMR results are otherwise consistent with the GALL report, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.2.12 Crack Initiation and Growth Due to Stress-Corrosion Cracking and Irradiation-Assisted Stress-Corrosion Cracking

Crack initiation and growth due to SCC and irradiation-assisted stress-corrosion cracking (IASCC) could occur in the baffle/former assembly bolts. The GALL Report states that the applicant is to provide a plant-specific AMP to manage this potential aging effect. Acceptance

criteria are described in BTP RLSB-1 (Appendix A of the SRP-LR). The staff has reviewed the applicant's proposed program to ensure that an adequate program is in place to manage these aging effects.

VCSNS has instituted the Reactor Vessel Internals Inspection Program (LRA Section B.2.4) to manage crack initiation and growth due to SCC and IASCC in the baffle/former assembly bolts. The program relies on the use of volumetric and visual examination techniques to detect the aging effects. For accessible locations in the bolts, an enhanced visual inspection will be performed to detect the presence and extent of cracking due to SCC and IASCC. For inaccessible locations, such as the junctures of bolt heads and shanks, a volumetric inspection will be performed to detect cracking due to SCC and IASCC.

GALL notes that, historically, the VT-3 visual examinations have not identified baffle/former assembly bolt cracking because this cracking occurs at the junctures of the bolt heads and shanks, which are not accessible for visual inspection. However, recent UT examinations of these components have identified cracking in several plants. GALL states that the industry is currently addressing the issue of baffle bolt cracking in the PWR MRP ITG activities to determine, develop, and implement the necessary steps and plans to manage the applicable aging effects on a plant-specific basis. The plant-specific basis selected by the applicant is volumetric inspection under the Reactor Vessel Internals Inspection Program. The staff requested, in RAI 3.1.2.2.12-1, that the applicant describe how it determines the threshold for cracking due to IASCC of the baffle former bolts, what percentage of the bolts will be selected for inspection, and what the technical basis is for this selection process. In response to the RAI, the applicant stated that it would follow and implement the staff-approved recommendations of the industry initiatives applicable to inspection of vessel internals for cracking due to SCC and IASCC. The applicant has agreed that this is a licensee commitment and this commitment is documented in Appendix A of this SER.

On the basis of its review, the staff finds that the applicant has appropriately evaluated AMR results involving management of crack initiation due to SCC and IASCC for the baffle/former assembly bolts, as recommended in the GALL report. Since the applicant's AMR results are otherwise consistent with the GALL report, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.2.13 Loss of Preload Due to Stress Relaxation

Loss of preload due to stress relaxation could occur in the baffle/former assembly bolts and the upper and lower internals assembly. The GALL Report states that the applicant is to provide a plant-specific AMP to manage this potential aging effect. Acceptance criteria are described in BTP RLSB-1 (Appendix of the SRP-LR). The staff has reviewed the applicant's proposed program to ensure that an adequate program is in place to manage these aging effects.

VCSNS has instituted the Reactor Vessel Internals Inspection Program (LRA Section B.2.4) to manage loss of preload due to stress relaxation, which could occur in the PWR reactor internals, including the baffle/former assembly bolts, and the upper and lower internals assembly. The program relies on the use of visual examination techniques to detect loose or missing bolts. This is acceptable because the intended functions of reactor vessel internals can

be maintained with fewer than 100 percent of the bolts intact. The applicant will determine the number of bolts needed for maintaining the intended functions and their locations by analysis prior to the inspection. The applicant also stated that VCSNS will follow the practices that are developed from industry initiatives, specifically EPRI and Westinghouse Owners Group (WOG) activities, and operating experience for the Reactor Vessel Internals Inspection Program. The review of this program is presented in Section 3.1.2.3.7 of this SER.

On the basis of its review, the staff finds that the applicant has appropriately evaluated AMR results involving management of loss of preload due to stress relaxation for the baffle/former assembly bolts, as recommended in the GALL report. Since the applicant's AMR results are otherwise consistent with the GALL report, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.2.14 Loss of Section Thickness Due to Erosion

The SRP-LR identifies loss of section thickness due to erosion as an aging effect that could occur at the feedwater impingement plate and support in the SGs. The GALL Report recommends further evaluation of the effectiveness of the applicant's plant-specific AMP to ensure that this aging effect is adequately managed. The applicant addressed this aging effect in LRA Table 3.1-1, Item 14. In its discussion, the applicant stated that the feedwater impingement plate and support do not have a license renewal intended function for VCSNS and aging management is therefore not required. However, the applicant provides no justification for this conclusion.

In RAI 3.1.2.2.14-1, the staff requested the applicant to provide the technical basis for excluding the SG feedwater impingement plate and support from the scope of license renewal. In its response to RAI 3.1.2.2.14-1, the applicant stated that the Delta 75 SGs in VCSNS do not have a feedwater impingement plate. However, there is a similar component, a baffle plate, designed to carry emergency feedwater (auxiliary feedwater) to prevent cold water spraying on the hot shell during filling or transients. But emergency feed is not used during normal operation. Therefore, erosion of the baffle plate is not an aging effect requiring management.

On the basis of its review, the staff finds that the applicant appropriately evaluated AMR results involving management of loss of section thickness due to erosion, as recommended in the GALL report. Since the applicant's AMR results are otherwise consistent with the GALL report, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.2.15 Crack Initiation and Growth Due to Primary Water Stress-Corrosion Cracking, Outside Diameter Stress Corrosion Cracking and/or Intergranular Attack; Loss of Material Due to Wastage and Pitting Corrosion and Fretting and Wear; or Deformation Due to Corrosion at Tube Support Plate Intersections

The SRP-LR identifies the following aging effects that could occur in Alloy 600 components of the SG tubes, repair sleeves and plugs—crack initiation and growth due to PWSCC, outside diameter stress-corrosion cracking ODSCC, or intergranular (IGA); loss of material due to

wastage and pitting corrosion, and fretting and wear; or deformation due to corrosion at tube support plate intersections. To manage these aging effects, the GALL Report identifies the AMPs programs as GALL AMP XI.M19, “Steam Generator Tubing Integrity,” and GALL AMP XI.M2, “Water Chemistry”.

The GALL Report further states that all PWR licensees have committed voluntarily to a steam generator degradation management program described in NEI document, NEI 97-06, “Steam Generator Program Guidelines.” The GALL Report recommends that an AMP based on the recommendations of the NEI 97-06 guidelines, or some other alternate regulatory basis for SG degradation management, should be developed to ensure that these aging effects are adequately managed.

Presently, the staff does not plan to endorse NEI 97-06 or the industry guidelines referenced therein. The staff is working with the industry to revise plant technical specifications to incorporate the essential elements of NEI 97-06 as necessary to ensure tube integrity is maintained. This would require implementation of SG programs to ensure that performance criteria for tube structural and leakage integrity are maintained, consistent with the plant design and licensing basis. NEI 97-06 provides guidance on programmatic details for accomplishing this objective. These guidelines apply to all degradation or damage mechanisms. However, these programmatic details would be outside the scope of the technical specifications.

As part of the NRC Reactor Oversight Program, the NRC would monitor the effectiveness of these programs in terms of whether the bottom line goals of these programs are being met, particularly whether the tube structural and leakage integrity performance criteria are in fact being maintained. The staff reviewed the applicant’s proposed steam generator program to ensure that an adequate program will be in place for the management of the aging effects associated with the SG components for the period of extended operation.

The applicant stated that the original steam generators at VCSNS were replaced in 1994 with Westinghouse Delta 75 steam generators. The replacement steam generators have thermally treated Alloy 690 tubes rather than the Alloy 600 tubes identified in GALL, Chapter IV.D1. The replacement steam generators have never been exposed to phosphate water chemistry; therefore, loss of material due to wastage is not an applicable aging effect. In addition, the replacement steam generators have support plates made of Type 405 stainless steel instead of carbon steel. Therefore, deformation due to corrosion at the tube support plate intersections is not an applicable aging effect. The applicant has proposed to manage the following applicable aging effects to the SG tubes, repair sleeves, and plugs by the Steam Generator Management Program (LRA Appendix B.1.10) and the Chemistry Program (LRA Appendix B.1.4)—(1) crack initiation and growth due to PWSCC, ODSCC, or IGA, (2) loss of material due to pitting corrosion, or (3) loss of section thickness due to fretting and wear.

The applicant also stated that the Steam Generator Management Program is consistent with GALL AMP XI.M19, “Steam Generator Tube Integrity,” and is structured to meet NEI 97-06. The staff issued RAI 3.1.2.2.15-b, requesting the applicant to confirm whether there are any alternate regulatory bases (i.e., alternate repair criteria) for VCSNS steam generators. In its response to RAI 3.1.2.2.15-b, the applicant stated that there are no alternate repair criteria for the replacement SGs at VCSNS. The staff’s review of the Steam Generator Management Program is discussed in Section 3.1.2.3.5 of this SER. The staff’s review of the Chemistry Program is discussed in Section 3.0.3.2 of this SER.

The Delta 75 steam generator design incorporates the main characteristics of the Westinghouse Model F design and is described in a Westinghouse report, “Westinghouse Delta 75 Steam Generator Design and Fabrication Information for the Virgil C. Summer Nuclear Station,” WCAP-13480, Revision 1, October 1993. The report states that the corrosion resistance of thermally treated Alloy 690 tubes has been proven not only by years of laboratory testing, but also in actual plant operation. The report further states that in 16 years of installing Alloy 690 tubing in steam generator and in operating 8 Westinghouse steam generators with Alloy 690 tubes, no indications on outer surface or inner surface tube corrosion have occurred. Also, EPRI report TE-106365-R14 states that virtually no cracking due to PWSCC, ODSCC, or IGA, as well as no loss of material due to pitting corrosion of Alloy 690 tubes has occurred after many years of operation in U.S. steam generator service. However, the EPRI report mentions that a small number of Alloy 690 tubes have been plugged due to wear.

In RAI 3.1.2.2.15-2, the staff requested the applicant to describe the design features incorporated in Delta 75 steam generators at VCSNS to minimize tube degradation due to wear. In its response to RAI 3.1.2.2.15-2, the applicant referred to the Westinghouse report, WCAP-13480, Revision 1, which identifies several enhancements to antivibration bars (AVB) to minimize wear on tubes including (1) use of Type 405 stainless steel material, (2) adoption of rectangular AVB configuration, (3) use of four sets of AVBs, and (4) tight control of AVB insertion depth. Increasing the number of sets of AVBs reduces the number of tubes that are potentially affected by the vibration mechanisms to which tube degradation has been attributed in some conventional steam generators. In addition, Delta 75 steam generators have small (0.003 in.) U-bend gaps and a tightly controlled U-bend tubing ovality. The report states that these two features have been proven through analytical assessment to reduce wear potential by more than an order of magnitude. The staff finds the applicant’s response to RAI 3.1.2.2.15-2, acceptable because the design of the replacement steam generator minimizes the potential for tube degradation due to wear.

On the basis of its review, the staff finds that the applicant has appropriately evaluated AMR results involving management of (1) crack initiation and growth due to PWSCC, ODSCC, and/or IGA, (2) loss of material due to wastage and pitting corrosion, (3) loss of material due to fretting and wear, or (4) denting due to corrosion of carbon steel tube support plate in the SG tubes and plugs, as recommended in the GALL Report. Since the applicant’s AMR results are otherwise consistent with the GALL report, the staff finds that the applicant has demonstrated that these aging effects will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.3 Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Components

To perform its evaluation, the staff reviewed the components listed in LRA Tables 2.3-1 through 2.3-7 to determine whether the applicant had properly identified the applicable AMRs and AMPs needed to adequately manage the aging effects for the components. This portion of the staff’s review involved identification of the aging effects for each component, ensuring that each aging effect was evaluated using the appropriate AMR in LRA Section 3, and ensuring that the management of the aging effect was captured in the appropriate AMP.

The staff also reviewed the FSAR supplements for the AMPs credited with managing aging in reactor system components to determine whether the program descriptions adequately describe the programs.

The applicant credits 12 AMPs to manage the aging effects associated with components in the reactor systems. Three of these AMPs are credited to manage aging for components in other system groups (common AMPs), whereas the remaining eight AMPs are credited with managing aging only for reactor system components. The staff's evaluation of the common AMPs that are credited with managing aging in reactor system components is provided in Section 3.0.3 of this SER. The common AMPs with respect to the RCS include the following programs:

- Boric Acid Corrosion Surveillance Program
- Chemistry Program
- Inservice Inspection (ISI) Plan

The staff's evaluation of the nine reactor system-specific AMPs is provided below.

3.1.2.3.1 Alloy 600 Aging Management Program

The applicant described its Alloy 600 Aging Management Program (AMP) in LRA Appendix B.1.1. This is an existing program and the applicant stated that the program is consistent with GALL AMP XI.M11, "Nickel-Alloy Nozzles and Penetrations." The AMP is credited for managing cracking in Alloy 600 vessel head penetrations.

The staff reviewed the applicant's description of the program in LRA Appendix B, Section B.1.1 to determine whether the applicant demonstrated that it will adequately manage the applicable aging effects in VCSNS during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Summary of Technical Information in the Application

The applicant stated that the program does not rely on an enhanced leakage detection system for detection of small leaks caused by PWSCC during plant operation, as suggested by GALL XI.M11. Instead, the program relies on detecting PWSCC cracks by means of inspecting for signs of boric acid leakage during outages, and by monitoring primary coolant leakage, per technical specifications, during plant operation before the intended function of the integrity of the pressure boundary is compromised. In addition, the applicant stated that the program will be enhanced according to the changes indicated by emerging regulatory requirements and identified by industry programs.

The applicant summarized its operating experience related to PWSCC cracking in Alloy 600 vessel head penetrations and in Alloy 82/182 weld between the RCS piping and the vessel outlet nozzle. For vessel head penetrations, the applicant briefly described its responses to NRC Bulletins 2001-01 and 2002-01. In describing recent industry experience, the applicant mentioned that the VCSNS response to NRC Bulletin 2001-01 stated that VCSNS performed VT-3 inspections of the interior surface of the reactor vessel head in April 1999 and found no recordable indications. The applicant also stated that VCSNS addressed the three license renewal issues identified in the NRC closure letter from K.R. Cotton to G.J. Taylor, dated

December 17, 1999, in SCE&G response to GL 97-01. The applicant stated (1) VCSNS vessel head penetrations have low susceptibility to PWSCC during the extended operating period, (2) the vessel head penetrations are included within the scope of the Boric Acid Corrosion Surveillances Program, and (3) the results of inspections are summarized as part of the operating experience (no recordable indications found) and documented in the response to NRC Bulletin 2001-01.

Staff Evaluation

The applicant stated that its Alloy 600 AMP is consistent with GALL XI.M11, which describes a program for managing cracking in the vessel head penetrations due to PWSCC. However, the review of the aging management results for Alloy 600 components presented in the LRA implies that the scope of the applicant's program is broader. The staff issued RAI B.1.1-5, requesting the applicant to clarify this discrepancy. In response to RAI B.1.1-5, in a letter dated June 12, 2003, the applicant stated that the scope of its program is broader and includes the following Alloy 600 components, in addition to reactor head penetrations:

- reactor vessel bottom head penetration tubes
- pressurizer nozzle-safe end weld metal (alloy 82/182)
- other dissimilar metal welds (alloy 82/182 welds)
- steam generator primary side tubesheet
- reactor vessel core support pads

The staff finds this explanation acceptable because it is consistent with the AMR results presented in LRA Tables 3.1-1 and 3.1-2.

As suggested in the NRC closure letter from K.R. Cotton to G.J. Taylor, dated December 17, 1999, for SCE&G response to Generic Letter 97-01, the LRA should include a summary of the results of any inspections that have been completed on VCSNS vessel head penetrations prior to the LRA. Therefore, the staff requested the applicant to provide information on the (1) number of vessel head penetrations inspected and their locations on the vessel head, (2) inspection methods used, (3) number of Alloy 82/182 attachment welds inspected, and (4) inspection results. In response, the applicant states that a remote visual examination of the area between the reactor vessel head insulation and the reactor vessel head was conducted during RF-13. The examination included inspection of all reactor vessel head penetration including vent pipe. The inspection showed no evidence of recent boric acid leakage from any reactor vessel head penetration. The specific information for this examination may be found in a letter from S.A. Byrne of SCE&G to the Public Document Room dated July 3, 2002. The applicant also performed an inspection of the underside of the vessel head using a remotely operated camera to detect any significant indication of cracking or loss of material. It did not find any recordable indications.

The program relies on detecting PWSCC cracks in head penetrations by means of inspection for signs of boric acid leakage during outages. The staff issued an RAI requesting the applicant to (1) confirm that the boric acid leakage inspection includes inspection of bare vessel head, (2) confirm that after the inspection vessel head will be cleaned of any boric acid deposits, (3) confirm whether an ASME VT-2 examination method is used to detect leakage through a crack in the vessel head penetration, and (4) since the leakage through a PWSCC crack is generally very small, provide the technical basis for ensuring that the boric acid leakage

inspection will be able to detect such a small leakage. In response, the applicant stated that it used ASME VT-2 examination for boric acid inspections of the reactor head during the refueling outage (RF) 13. When leaks are found, the affected components are evaluated for impact, corrective actions are implemented as appropriate, and boric acid residue is removed.

The applicant further stated that in response to NRC Bulletin 2002-02, a “bare metal inspection” of the reactor head is scheduled for the RF-14 using the guidance of the EPRI MRP report, “PWR RPV Upper Head Penetrations Inspection Plan (MRP-75),” Revision 1, Report 1007337. A “bare metal inspection” consists of a detailed visual examination meeting the following three requirements:

- optical aids used should be able to resolve the 4-millimeter (mm) character height under conditions similar to those for the actual inspection,

- the entire intersection between the reactor pressure vessel (RPV) head and each penetration should be readily viewed, as well as 12 mm (0.5 in.) of the adjacent bare surface of the upper head

- additional examination of uncertain deposits to further discriminate between the possible sources of origin may require additional optical aids with greater resolution.

The applicant further stated that its experience with leaks is consistent with the assumption that boric acid leakage inspection will detect leaks more reliably than leak rate surveillance. The staff finds the applicant’s response acceptable because the boric acid inspections performed following the EPRI MRP guidance will be capable of detecting very small leak rates.

The applicant stated that the program will be enhanced according to the changes indicated by emerging regulatory requirements and identified by industry programs. However, the Alloy 600 AMP, described in LRA Section B.1.1, does not specify whether the applicant would participate in the industry program for managing PWSCC-type aging on vessel head penetrations and implement its recommendations. Therefore, the staff issued an RAI about the applicant's involvement in the industry program. In response, the applicant stated that it is participating in the industry program for managing PWSCC-type aging on vessel head penetrations. The staff finds this response acceptable because the program carried out by the EPRI MRP is the main industry program addressing the issue of PWSCC cracking of vessel head penetration and other Alloy 600 components and Alloy 82/182 welds. The applicant has agreed that this is a licensee commitment and this commitment is documented in Appendix A of this SER.

The FSAR Supplement for this program is presented in LRA Appendix A, Section 18.2.4. The supplement states that the pressurizer and steam generator subcomponents, in addition to the vessel subcomponents, are within the scope of the program. The staff concludes that the applicant’s FSAR Supplement provides an adequate description of the programs credited with managing this aging effect, as required by 10 CFR 54.21(d).

<u>Conclusions</u>

On the basis of its review and audit of the applicant’s program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, the

applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.1.2.3.2 Bottom-Mounted Instrumentation Inspection Program

The applicant described its Bottom-mounted Instrumentation Inspection Program in LRA Appendix B.1.3. This is an existing, plant-specific program. The applicant credits this AMP for managing loss of material due to wear of the thimble tubes. There is no corresponding AMP in GALL, but GALL suggests a program based on recommendations of NRC I&E Bulletin 88-09, “Thimble Tube Thinning in Westinghouse Reactors."

Summary of Technical Information in the Application

The objective of the program is to identify loss of material, (i.e., tube wall thinning) due to fretting wear in the bottom-mounted instrumentation (BMI) thimble tubes, prior to loss of their intended function through leakage and loss of pressure boundary. The applicant stated that the program is a condition monitoring program. The program includes inspection of all VCSNS BMI thimble tubes using eddy current testing (ECT). The ECT data are trended, wear rates are calculated, and inspections are planned prior to the refueling outage at which thimble tube wear is predicted to exceed the acceptance criteria of 75 percent loss of initial wall thickness. The corrective actions include capping, repositioning, or replacing a thimble tube if predicted tube wear exceeds the acceptance criteria.

The applicant summarized its operating experience related to thimble tube wear by briefly describing its response to NRC IEB 88-09. Since issuance of the bulletin, the applicant has performed four inspections (RF-4 ,R-5, R-6, and RF-13) of BMI thimble tubes at VCSNS and repositioned several of them. Based on the calculations performed using the results of these inspections, the applicant determined that the next ECT is not required on the thimble tubes until RF-14.

Staff Evaluation

The staff reviewed the applicant’s description of the program in LRA Appendix B.1.3 to determine whether the applicant demonstrated that it will adequately manage the applicable aging effects at VCSNS during the period of extended operation, as required by 10 CFR 54.21(a)(3).

[Program Scope] The objective of the subject program is to monitor tube wall degradation, (i.e., loss of wall due to fretting wear) of all thimble tubes installed in the VCSNS reactor pressure vessel. The staff finds that the scope of the subject AMP is adequate because it includes inspection of all thimble tubes that are susceptible to wall thinning due to fretting wear caused by flow-induced vibrations.

[Preventive or Mitigative Actions] The subject program is a condition monitoring program. There are no preventive or mitigative attributes associated with the program, nor did the staff identify a need for such.

[Parameters Monitored/Inspected] The subject program monitors BMI thimble tube wall degradation (loss of material due to fretting wear). The staff finds this acceptable because tube wall degradation directly relates to the thimble tube capacity to perform its intended function of maintaining the integrity of reactor coolant pressure boundary.

[Detection of Aging Effects] The subject program monitors tube wall degradation in 100 percent of the BMI thimble tubes using ECT. The staff issued RAI B.1.3-1, requesting the applicant to submit information about whether the entire length of each thimble tube is inspected, and if not, to present the technical basis for not doing so. In response to RAI B.1.3-1, in a letter dated June 12, 2003, the applicant stated that the full length of each BMI thimble tube is inspected. The applicant also stated that the eddy current inspection performed during RF-4 detected wear occurring at the core plate or fuel assembly bottom nozzle area. The staff finds the response acceptable because these wear locations are consistent with the wear locations reported in the NRC IEB 88-09 and NRC IN 87-44, “Thimble Tube Thinning in Westinghouse Reactors.”

The applicant stated that the frequency of ECT examination is based on an analysis of data obtained using the wear rate relationships developed based on Westinghouse research. The staff issued RAI B.1.3-2, requesting the applicant to submit an explanation for the wear rate relationships and describe the Westinghouse research. This RAI was discussed during a June 22, 2003, conference call. As a result of the conference call, the applicant provided the following additional information in response to RAI B.1.3-2.

Research was performed for the WOG and is documented in WCAP-12866. WCAP-12866 includes an evaluation of a large amount of operating experience from multiple plants. Data from multiple thimble tubes at these plants were evaluated for wear. The wear was typically evaluated over one operating cycle, but two, and even three, cycles of wear data were used in the research. Hot cell examination of worn thimbles was performed and its results were compared with eddy current data. The comparison determined that eddy current data conservatively predict the extent of loss of material due to wear. The staff finds the use of ECT data from the Westinghouse research for developing wear rate relationship acceptable because the wear data are obtained from thimble tubes in several plants, they cover one to three operating cycles, and they conservatively predict the extent of loss of material due to wear.

[Monitoring and Trending] The applicant stated that the ECT results are trended, wear rates are calculated, and inspections are planned prior to the refueling outage in which thimble tube wear is predicted to exceed the acceptance criteria. Regarding the predicted wear rate, the IEB 88-09 states that, based on the available data, it is not possible to accurately predict thimble tube wear rates because several plant-specific factors affect the wear rate including the gap distance from the lower core plate to the fuel assembly instrument tube, the amount of clearance between the thimble tube and the guide tube, the axial component of the local fluid velocity, the thickness of the thimble tube, and the moment of inertia of the thimble tube. In describing its operating experience, the applicant stated that, based on the analysis of the wear rate data derived from the eddy current inspections performed at RF-4 and RF-5, the next inspection of the thimble tubes is not required until RF-14. The staff issued RAI B.1.3-3, requesting the applicant to explain and justify the use of this extrapolation of the limited inspection results over nine refueling cycles for scheduling the next inspection of the thimble tubes.

In response to RAI B.1.3-3, in a letter dated June 12, 2003, the applicant submitted the following information. VCSNS now has four sets of data for wear of its thimble tubes. Data have been gathered in RF-4, RF-5, RF-6 and RF-13. The highest recorded measurement in RF-4 and RF-13, respectively, was 38 percent and 57 percent of the initial wall thickness. The applicant used the wear rate relationship developed by Westinghouse to predict the wear damage based on RF-13 measurements. The projections for wear at RF-17 are all below 75 percent of the initial wall thickness and the highest wear predicted for RF-18 is between 75 percent and 80 percent of the initial wall thickness. The acceptance criterion for wear damage is 75 percent loss of initial wall thickness. VCSNS plans to perform the next inspection of thimble tubes in RF-17. The staff finds the VCSNS monitoring and trending activities acceptable because the extrapolation is based on inspection results from four refueling cycles. The relationship developed by Westinghouse conservatively predicts the extent of loss of material due to wear for one to three operating cycles. The staff finds this acceptable because the Westinghouse relationship will be periodically evaluated by the applicant

[Acceptance Criteria] The subject program uses 75percent loss of initial wall thickness as an acceptance criterion. The staff issued RAI B.1.3-4, requesting the applicant to submit the technical justification for this criterion and explain how the allowances for such items as inspection methodology and wear scar geometry uncertainties, which were identified in IEB 88-09, are included in the criterion. In response to RAI B.1.3-4, in a letter dated June 12, 2003, the applicant stated that the wear relationship developed by Westinghouse makes allowances for the uncertainties. The Westinghouse methodology has an acceptance criterion of 80 percent, whereas VCSNS uses 75 percent for additional conservatism. The staff finds the response acceptable because the acceptance criterion adopted by VCSNS is more conservative than the one recommended by Westinghouse and it allows for the uncertainties as identified by IEB 88-09.

[Operating Experience] Since the issuance of IEB 88-09, the applicant has performed four inspections (RF-4, -5, -6, and -13) of thimble tubes at VCSNS. The applicant reported that several thimble tubes were repositioned in RF-5, but no thimble tubes have been capped or required replacement.

The FSAR Supplement for this program is presented in LRA Appendix A, Section 18.2.8. The staff concludes that the applicant's FSAR Supplement provides an adequate description of the program credited with managing this aging effect, as required by 10 CFR 54.21(d).

Conclusions

On the basis of its review of the applicant's program, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.1.2.3.3 In-Service Inspection Plan (ISI)

The applicant described its In-Service Inspection (ISI) Plan in LRA Appendix B.1.7. The plan is based on the ASME Code Section XI in-service inspection requirements. Throughout the

service life of nuclear power plants, Class 1 components and associated Class 1 supports must meet the requirements set forth in Section XI of the ASME Code and Addenda that are incorporated by reference in 10 CFR 50.55a(b).

Inservice examinations and system pressure tests conducted during successive 120-month inspection intervals, following the initial 120-month ISI interval, must comply with the requirements of the latest edition and addenda of the Code incorporated by reference in 10 CFR 50.55a(b) twelve months prior to the start of the 120-month inspection interval, subject to the limitations and modifications, such as code editions and addenda, as listed in paragraph 10 CFR 50.55a(b)(2)(i).

The period of extended operation will contain the fifth and sixth ISI interval. The ISI plan for each interval of the renewed license period of extended operation for VCSNS will comply with 10 CFR 50.55a(g)(4)(ii) except that if an examination required by the Code or Addenda is determined to be impractical, then the applicant will submit a relief request to the Commission in accordance with the requirements contained in 10 CFR 50.55a(g)(5)(iii) and (iv), for Commission evaluation, as required by 10 CFR 50.55a(g)(6)(i).

<u>Summary of Technical Information in the Application</u>

The Inservice Inspection Plan is an existing program. The applicant states that the program is consistent with GALL AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, IWD," with the following clarification: VCSNS is committed to the 1989 Edition of ASME Section XI with no addenda for the second ten-year inspection interval. In addition, VCSNS has adopted the 1995 Edition of ASME Section XI with 1996 Addenda for ultrasonic examination requirements, which includes mandatory Appendices VII and VIII. VCSNS has performed Inservice inspections in accordance with the relevant portions of approved editions of ASME Code Section XI from the beginning of its operation in 1982.

As part of the operating experience, the applicant mentions the primary water SCC of the reactor vessel "A" hot leg nozzle that resulted in leakage, which was discovered in 2000 during RF-12. The applicant states that the leakage was detected by virtue of boric acid residue, and confirmed by volumetric examination. The crack was inspected, evaluated and repaired in accordance with ASME Section XI criteria.

<u>Staff Evaluation</u>

In LRA Appendix B.1.7, "In-Service Inspection (ISI) Plan," the applicant describes its AMP for detecting and managing aging effects of ASME code components in the reactor coolant system. The LRA states that this AMP is consistent with GALL AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, IWD," with no deviation. The staff confirmed the applicant's claim of consistency during the AMR inspection. In addition, for VCSNS, the staff determined whether the applicant properly applied the GALL program to its facility.

The plant operating experience, described in the LRA, has indicated that the VCSNS ISI plan has been effective in detecting and managing aging effects in ASME code components in the reactor coolant system identified in Tables 3.1-1 and 3.1-2 of the LRA for which the ISI plan is identified as an AMP. The staff, therefore, has determined that the applicant's ISI plan will

adequately manage the aging effects in the components identified in the tables during the period of extended operation.

The FSAR Supplement for this program is presented in LRA Appendix A, Section 18.2.19. The staff concludes that the applicant's FSAR Supplement provides an adequate description of the program credited with detecting and managing aging effects in ASME code components in the reactor coolant system, as required by 10 CFR 54.21(d).

Conclusion

On the basis of its review and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.1.2.3.4 Reactor Head Closure Studs Program

The applicant describes its reactor head closure studs program in LRA Appendix B.1.8. This is an existing program and the applicant states that the program is consistent with GALL AMP XI.M3, "Reactor Head Closure Studs." The AMP is credited for managing loss of mechanical closure integrity for the reactor head closure stud bolting subject to SCC, stress relaxation, and wear. The staff reviewed the applicant's description of the program in LRA Appendix B, Section B.1.8, to determine whether the applicant has demonstrated that it will adequately manage the applicable aging effects in VCSNS during the period of extended operation as required by 10 CFR 54.21(a)(3).

Summary of Technical Information in the Application

The applicant states that the program will manage aging effect of loss of closure integrity rather than loss of material, loss of preload and cracking of closure studs. The program is largely dependent upon the Inservice inspection plan, which includes ASME Code Section XI inspections. VCSNS has performed Inservice inspections in accordance with the relevant portions of ASME Code Section XI from the beginning of its operation in 1982, and no damage to the reactor head closure studs has been detected.

Staff Evaluation

In LRA Table 3.1-1, AMR Item 18, the applicant states that the aging effect requiring management is loss of closure integrity rather than loss of material, loss of preload, and cracking of closure studs, which are managed by GALL AMP XI.M3. The staff requested the applicant to describe the difference between loss of closure integrity and the aging effects managed by GALL XI.M3. In response, the applicant stated that loss of mechanical closure integrity can result in failure of the mechanical joint and is evidenced by leakage rather than joint failure. This failure can be attributed to loss of bolt preload, loss of bolting material by wear, and cracking of high strength bolting material. Therefore, management of loss of closure

integrity is the same as management of loss of preload, loss of material, and cracking of bolting materials. The applicant is managing the loss of closure integrity with the ISI plan, which includes surface and volumetric inspections for detecting cracking and loss of material in closure head studs, nuts, threads in flange, washers and bushings at each refueling outage when the reactor closure head is disassembled and reassembled. Retorquing of the closure studs during reassembly will establish the desired preload. Thus, any loss of preload that might have occurred during previous operation would be removed during a refueling outage. Therefore, the applicant's management of loss of mechanical closure integrity is adequate for managing the aging effects of loss of material, cracking, and loss of preload.

The FSAR Supplement for this program is presented in LRA Appendix A, Section 18.2.27. The staff concludes that the applicant's FSAR Supplement provides an adequate description of the programs credited with managing this aging effect, as required by 10 CFR 54.21(d).

Conclusions

On the basis of its review and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.1.2.3.5 Steam Generator Management Program

The applicant described its Steam Generator Management Program in LRA Appendix B, Section B.1.10. This is an existing program, and the applicant stated that the program is consistent with GALL AMP XI.M19, "Steam Generator Tube Integrity." This AMP, along with the Chemistry Program described in LRA Appendix B, Section B.1.4 is credited with managing cracking and loss of material in steam generator tubes, tube plugs, shell, and internals.

The staff reviewed the applicant's description of the program in LRA Appendix B, Section B.1.10 to determine whether the applicant demonstrated that the program will adequately manage the applicable aging effects in VCSNS SGs during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Summary of Technical Information in the Application

The replacement steam generators were installed during RF-8 in 1994. The applicant stated that the existing Steam Generator Management Program was first applied to the replacement steam generators when a partial eddy current inspection of steam generators A and B was conducted and a moisture carryover modification was carried out during RF-9. During RF-10 and RF-11, the applicant partially inspected steam generators A, B, and C. During RF-12, the applicant inspected tubes in all three SGs and performed a full secondary-side inspection. The applicant stated that no significant degradation was found during any of these inspections.

Staff Evaluation

In LRA Appendix B, Section B.1.10, the applicant stated that the Steam Generator Management Program is consistent with GALL AMP XI.M19; no deviations were noted. In RAI B.1.10-3, the staff requested the applicant's clarification regarding why the scope of the applicant's AMP is different from GALL AMP XI.M19. In its response to RAI B.1.10-3, the applicant explained that the scope of GALL AMP XI.M19 is specific to SG tubes, whereas the scope of the applicant's AMP includes SG shell and internals, such as AVBs and the feedwater distributor, in addition to tubes and plugs. The staff finds the applicant's response to RAI B.1.10-3, acceptable because the applicant's Steam Generator Management Program is more comprehensive than GALL XI.M19 in the management of steam generator components.

The application of the applicant's AMP for managing crack initiation and growth due to PWSCC, ODSCC, or IGA; loss of material due to wastage and pitting corrosion and fretting and wear; or deformation due to corrosion in Alloy 690 components of the SG tubes and plugs is reviewed in Section 3.1.2.2.15 of this SER. The staff finds that these are the applicable aging effects for SG tubes and that the applicant's Steam Generator Management Program will adequately manage the applicable aging effects for Alloy 690 tubes and plugs.

The applicant stated that a 100 percent secondary-side inspection was performed during RF-12. The staff issued RAI 3.1.2.2.2-1, requesting the applicant to submit a summary description of this inspection, including a list of components inspected, type of inspection performed, and frequency of such inspection during the extended period of operation. This RAI was further discussed with the applicant during a June 22, 2003, conference call. In its additional response to RAI 3.1.2.2.2-1, in a letter dated September 2, the applicant provided the following additional information. The applicant states that the secondary-side visual inspections were performed for evidence of corrosion, erosion, deposits, and hardware conditions in four locations in the replacement steam generators, including the upper steam drum region, mid/lower steam drum region, 9th tube support and U-bend region, and tubesheet and lower tube bundle region. Access to the inspection locations was provided by several different openings in the SGs. The inspections utilized several different types of remote camera equipment and delivery tooling depending on the component being viewed. None of the components inspected showed any sign of erosion, corrosion, or degradation. The applicant stated that the frequency of SG secondary side inspection at VCSNS is determined based on the inspection results and is performed periodically. The components that will be inspected during the extended period of operation are included in the Steam Generator Management Program (LRA B.1.10) and are similar to the components discussed above. The staff finds that the applicant's response to RAI 3.1.2.2.2-1 is acceptable because its SG management program will adequately manage the applicable aging effects on the secondary-side components.

The FSAR Supplement for the Steam Generator Management Program is presented in LRA Appendix A, Section 18.2.35. The supplement states that the program implements the requirements of VCSNS Technical Specification 4.4.5 and follows the recommendations provided by NEI and EPRI guidelines. In RAI B.1.10-3, the staff requested the applicant to update the FSAR Supplement to include NEI 97-06. In its response to RAI B.1.10-3 dated June 12, 2003, the applicant revised the FSAR Supplement to indicate that the scope of the Steam Generator Management Program includes inspection of other steam generator components, in addition to tubes and plugs. However, the applicant did not revise the FSAR Supplement to include NEI 97-06 because it stated that the staff had not approved NEI 97-06 and that NEI 97-06 may be revised in the future. The staff found that FSAR Supplement 18.2.35 was inadequate without a reference to NEI 97-06 because the industry has been using

the guidance in NEI 97-06 in its SG tube inspection. In addition, NEI 97-06 is referenced in GALL XI.M19 and NUREG-1800 as a document that is related to the SG tube inspection. In a letter dated September 2, 2003, the applicant revised FSAR Supplement 18.2.35 to include NEI 97-06. The staff concludes that the applicant's FSAR Supplement provides an adequate description of the programs credited with managing the aging effects in steam generator components subject to AMR, as required by 10 CFR 54.21(d).

Conclusions

On the basis of its review and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.1.2.3.6 Reactor Vessel Surveillance Program

The applicant described its Reactor Vessel Surveillance Program in LRA Appendix B.1.24. This is an existing program and the applicant stated that the program is consistent with GALL AMP XI.M31, "Reactor Vessel Surveillance." The AMP is credited for managing loss of fracture toughness in reactor vessel materials due to neutron irradiation embrittlement.

The staff reviewed the applicant's description of the program in LRA Appendix B, Section B.1.24 to determine whether the applicant demonstrated that it will adequately manage the applicable aging effects at VCSNS during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Summary of Technical Information in the Application

The applicant identified two enhancements to be incorporated into the Reactor Vessel Surveillance Program prior to the period of extended operation. The first included a one-time analysis to demonstrate that the materials in the inlet and outlet nozzles and upper shell course will not become limiting materials during the period of extended operation. The second called for removal of the two remaining surveillance capsules during RF-14 in accordance with the recommendations of Item 6 of the December 3, 1999, C. Grimes (NRC) letter to D. Walters (NEI). The applicant stated that the analysis of the VCSNS surveillance capsules removed to date demonstrates that changes of pressure vessel beltline material properties are well-known and will not result in brittle failure. The applicant further stated that a Westinghouse analysis has demonstrated that the VCSNS vessel beltline materials are below the RT_{PTS} screening criteria for 48 effective full-power (EFPY). The applicant will perform a further evaluation for 54 EFPY prior to the period of extended operation. The applicant also stated that the VCSNS Fuel Loading Program was revised to implement a low-leakage pattern that reduced the neutron flux and, therefore, neutron embrittlement of the reactor vessel.

Staff Evaluation

The applicant stated that its program is consistent with GALL AMP XI.M31. The recommendations of GALL AMP XI.M31 are similar to those of the December 3, 1999, C. Grimes letter to D. Walters (NEI). The VCSNS Reactor Vessel Surveillance Program consists of capsules with a projected fluence exceeding the 60-year fluence at the end of 40 years.

The applicant indicated that it will remove the two remaining surveillance capsules during RF-14. As a result, no surveillance capsules will be left in the vessel during the extended period of operation. Therefore, the staff identified in RAI B.1.24-1 that the applicant needs to confirm whether the operating restrictions will be established at the end of RF-14 to ensure that the plant is operated under conditions to which the surveillance capsules were exposed and that the exposure conditions of the reactor vessel will be monitored to ensure that they continue to be consistent with those used to project the effects of embrittlement to the end of license.

In addition, the applicant did not make any commitments for installing an alternative dosimetry for monitoring neutron fluence during the period of extended operation. GALL AMP Chapter XI.M31, “Reactor Vessel Surveillance,” recommends the use of alternative dosimetry for applicants without in-vessel capsules. In response to RAI B.1.24-1, the applicant stated that a program will be established at the end of RF-14 to ensure that the plant is operated under conditions to which the surveillance capsules were exposed and that the exposure conditions of the reactor vessel will be monitored to ensure that they continue to be consistent with those used to project the effects of embrittlement to the end of license. The applicant further states that this program may be supplemented or revised by using alternative dosimetry or other effective neutron monitoring techniques during the period of extended operation. The applicant has agreed that this is a licensee commitment and this commitment is documented in Appendix A of this SER. The staff finds these responses acceptable because they follow the recommendations of GALL AMP XI.M31.

By RAI B.1.24-3, the staff requested that the applicant describe the analysis for demonstrating that the materials in the inlet and outlet nozzles and upper shell course will not become limiting materials during the period of extended operation. In response, the applicant stated that it has performed an analysis for such demonstration. Since no information about the copper and nickel contents for the nozzle forgings was found in the material test reports for the vessel, the applicant used the values of 0.35 percent copper and 1.00 percent nickel, which are recommended in 10 CFR 50.61 when the values are not available. The highest temperature for the unirradiated reference temperature is 0 °F for one of the inlet nozzles. The applicant used this reference temperature in its analysis. For the nozzle, a distance of 8 feet from the core midplane to the edge of the nozzle was used for estimating the fluence value at the nozzle. Using these data, the applicant conservatively projected that the RT_{PTS} for the nozzle material at the 54 EFPY end of life (EOL) value is 145.2 °F. Therefore, the staff agrees with the applicant that the vessel nozzles do not become limiting for a 60-year plant life because the highest projected value for the vessel nozzles is below the limiting beltline plate material of 158.1 °F. A detailed discussion of the pressurized thermal shock (PTS) is provided in Section 4.2.2 of this SER.

The FSAR Supplement for this program is presented in LRA Appendix A, Section 18.2.29. The staff concludes that the applicant’s FSAR Supplement provides an adequate description of the programs credited with managing this aging effect, as required by 10 CFR 54.21(d).

Conclusions

On the basis of its review and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.1.2.3.7 Reactor Vessel Internals Inspection Program

The applicant described its Reactor Vessel Internals Inspection Program in LRA Appendix B.2.4. This is a new program and the applicant stated that the program is consistent with GALL AMP XI.M16, "PWR Vessel Internals," with clarifications.

The staff reviewed the applicant's description of the program in LRA Appendix B, Section B.2.4 to determine whether the applicant demonstrated that it will adequately manage the applicable aging effects at VCSNS during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Summary of Technical Information in the Application

The applicant's Reactor Vessel Internals Inspection Program is discussed in LRA Appendix B, Section B.2.4, and in Appendix A, FSAR Section 18.2.28. This is a new program, and the applicant stated that the program will be consistent with GALL AMP XI.M16, "PWR Vessel Internals." However, the applicant added the clarification that the VCSNS resolution criterion for the enhanced VT-1 inspection is expected to be less than that specified in the GALL program.

This new AMP is credited with managing the following aging effects:

- loss of fracture toughness in baffle/former bolts and other reactor vessel internals

- changes in dimension due to void swelling in reactor vessel internals, crack initiation and growth in baffle/former bolts, and other reactor vessel internals

- loss of preload in baffle/former bolts and other reactor internals and

- loss of material due to wear in reactor vessel internals

The applicant stated that this new inspection program will supplement the existing ISI Plan to assess the condition of RV internals. The applicant has identified the components that will be inspected under this program. For those components that are accessible or can be rendered accessible by the removal of the core and other internals for examination, a visual inspection will be performed to detect the presence and extent of cracking and loss of material. For bolts and other inaccessible components, a volumetric inspection will be performed to detect the

presence and extent of changes in dimensions, cracking, loss of preload, and reduction of fracture toughness.

Staff Evaluation

In LRA Appendix B, Section B.2.4, the applicant describes its AMP to manage aging processes in RV internals. The LRA states that this AMP is consistent with GALL AMP XI.M16, with the clarification that the resolution criterion for the enhanced VT-1 examination at the VCSNS is expected to be less than that specified in the GALL program. The staff requested in RAI B.2.4-1 that the applicant explain why it plans to use less than a 0.0005-in. resolution for the enhanced VT-1 examination to be employed at VCSNS. In response, the applicant stated that the capability to achieve a 0.0005-in. resolution for visual inspection has not been demonstrated in the field. The staff does not agree with the applicant because the boiling water reactor (BWR) Vessel Internals Program has developed such an enhanced visual inspection method for detecting cracks in BWR vessel internals. However, the applicant stated that the details of the Reactor Vessel Internals Inspection Program are not yet developed. The applicant further stated that it will follow industry initiatives and have a program in place prior to the period of extended operation. The staff finds the applicant's response acceptable because the recommendations of the industry initiatives will be reviewed and approved by the staff prior to entering its license renewal period.

The applicant does not provide information about the neutron fluence threshold that it will use to identify the vessel internals that are susceptible to loss of fracture toughness due to neutron irradiation embrittlement of the RV internal components. The staff issued RAI B.2.4-2, requesting the applicant to submit the neutron threshold value that it may use for identifying the vessel internals susceptible to loss of fracture toughness due to neutron irradiation embrittlement. In response to RAI B.2.4-2, in a letter dated June 12, 2003, the applicant stated that the details of the Reactor Vessel Internals Inspection Program have not been developed. The applicant further stated that VCSNS will follow industry initiatives and will have a program in place prior to the period of extended operation.

During a June 22, 2003, conference call, the staff requested that the applicant be more specific about how it will identify the vessel internals susceptible to loss of fracture toughness due to neutron embrittlement. In response, the applicant stated that it will consider operating experience gained from aging management activities performed by plants that were originally licensed before VCSNS. The staff finds this response acceptable because the applicant will develop the details of the Reactor Vessel Internals Inspection Program based on the operating experience of the plants that were originally licensed before VCSNS and have renewed their licenses. These plants would have several years of extended operating experience before VCSNS begins its extended period of operation. VCSNS will develop and implement a reactor vessel internals inspection program prior to the period of extended operation and will implement aging management activities that are acceptable to the staff. The applicant has agreed that this is a licensee commitment and this commitment is documented in Appendix A of this SER.

The staff also requested the applicant to provide information on how it will identify the RV internals components susceptible to IASCC and select them for inspection. In response, the applicant stated that it will follow industry initiatives and will have an inspection program in place prior to the period of extended operation. The staff finds the applicant's response acceptable

because the recommendations of the industry initiatives will be reviewed and approved by the staff. The applicant has agreed.

The FSAR Supplement for this program is presented in LRA Appendix A, Section 18.2.28. The staff reviewed that section and concluded that the applicant's FSAR Supplement provides an adequate description of the programs credited with managing this aging effect, as required by 10 CFR 54.21(d).

Conclusions

On the basis of its review and audit of the applicants program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. In addition, the staff has reviewed the exceptions to the GALL program and finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.1.2.3.8 Small Bore Class 1 Piping Inspection

The applicant described its Small Bore Class 1 Piping Inspection program in LRA Appendix B, Section B.2.7. This is a new program and the applicant stated that the program will be consistent with GALL AMP XI.M32, "One-Time Inspection."

This AMP, along with two existing AMPs, is credited with managing cracking in small-bore RCS and connected systems piping. The existing AMPs include the Chemistry Program described in LRA Appendix B, Section B.1.4 and the ISI Plan described in LRA Appendix B, Section B.1.7.

The staff reviewed the applicant's description of the program in LRA Appendix B, Section B.2.7 to determine whether the applicant demonstrated that it will adequately manage the applicable aging effects at VCSNS during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Summary of Technical Information in the Application

The applicant states that this new program will help in assessing the current condition of small bore piping that does not receive a volumetric examination. The applicant plans to perform the inspection near the end of the second period of the fourth ISI interval. The applicant plans to perform this inspection using destructive testing of selected samples. The applicant will identify the locations most susceptible to cracking based on engineering evaluation, operating experience, current code requirements, and industry initiatives. The applicant further stated that inspection locations will be selected by engineering judgment, using risk-based approaches. One of the sample locations will be a butt weld. Since the program plans to use destructive testing and replace the piping according to ASME Section XI, the applicant did not see a need to define a corrective action prior to inspection.

Staff Evaluation

In LRA Appendix B, Section B.2.7, the applicant describes its AMP to manage cracking in small bore piping. The LRA states that this AMP is consistent with GALL AMP XI.M32, with no deviations. As stated in Section 3.1.2.2.6, the applicant will follow ongoing industry activities related to failure mechanisms for small bore piping, including the recommendations of the EPRI-sponsored MRP ITG on Thermal Fatigue. The applicant presented a reasonable approach for identifying piping locations susceptible to damage. In response to an RAI, the applicant stated that it will select those sample locations for inspection that are bounding locations for Class 1 small bore piping within the scope of license renewal. Therefore, the applicant's approach for identifying susceptible locations and in selecting the sample locations for inspections is acceptable.

In response to an RAI regarding the inspection method, the applicant stated that it will inspect the small bore Class 1 piping using a methodology that is approved by the staff. However, the applicant does not want to commit to currently approved destructive examination techniques for inspecting small bore piping during the extended period of operation because industry may develop new, improved inspection techniques that VCSNS may want to employ at that time. The staff finds the applicant's commitment for inspecting the small-bore piping with an NRC-approved methodology acceptable.

The FSAR Supplement for this program is presented in LRA Appendix A, Section 18.2.34. The staff concludes that the applicant's FSAR Supplement provides an adequate description of the programs credited with managing this aging effect, as required by 10 CFR 54.21(d).

Conclusions

On the basis of its review and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.1.2.3.9 Thermal Fatigue Management Program

The applicant described its Thermal Fatigue Management Program in Section B3.2 of the LRA. This program monitors loading cycles due to pressure and temperature transients for selected critical components. The staff reviewed the applicant's description of the program in LRA Appendix B, Section B.3.2 to determine whether the applicant demonstrated that it will adequately manage the applicable aging effects at VCSNS during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Summary of Technical Information in the Application

The applicant indicated that this AMP is consistent with GALL AMP X.M1, with enhancements, and the scope of the program had been enhanced to incorporate the new guidance in EPRI Report MRP-47. In addition, the applicant committed to evaluate the effects of the reactor coolant environment on the component locations identified in NUREG/CR-6260 using the

appropriate environmental fatigue factors. The applicant stated that the Thermal Fatigue Monitoring Program (FMP) includes reviews of both industry and plant-specific operating experience regarding fatigue cracking for applicability to VCSNS.

Staff Evaluation

The applicant discussed the scope of the FMP in Section B3.2 of the LRA. The applicant indicated that the scope of the program was enhanced to incorporate new guidance in EPRI Report MRP-47. As discussed in Section 4.3 of this SER, the staff has not endorsed the guidelines provided in EPRI Report MRP-47. As a consequence, the staff did not rely on the guidance provided in MRP-47 for its review.

The VCSNS program monitors loading cycles due to pressure and thermal transients for the selected critical components discussed in Section 4.3 of this SER. The staff reviewed the transients monitored by the program and the applicant's evaluation of the effects of the reactor environment. The staff evaluation of the transients monitored by the TFMP and the applicant's evaluation of the effects of the reactor water environment are discussed in Section 4.3 of this SER. The staff found that the applicant identified the thermal transients that are significant contributors to the design fatigue usage of RCS components.

The staff also confirmed that the components monitored by the TFMP include the components identified in NUREG/CR-6260. As discussed in Section 4.3 of this SER, the applicant has committed to evaluate the impact of the reactor water environment of the components identified in NUREG/CR-6260 prior to the period of extended operation. In LRA Section B3.2, the applicant also committed to revise the TFMP acceptance criteria to account for the reactor water environmental effects prior to the period of extended operation. The staff finds that the applicant's proposed acceptance criteria is consistent with GALL AMP X.M1.

Conclusions

On the basis of its review and audit of the applicants program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. In addition, the staff has reviewed the enhancements to the GALL program and finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.1.2.4 Aging Management Review of Plant-Specific Reactor Vessel, Internals, and Reactor Coolant Components.

The reactor coolant mechanical components at VCSNS that requiring an AMR are described in the following sections of the LRA:

- reactor coolant system (2.3.1.1)
- piping, valves and pumps (2.3.1.2)
- reactor vessel (2.3.1.3)
- reactor vessel internals (2.3.1.4)

- in-core instrumentation system (2.3.1.5)
- pressurizer (2.3.1.6)
- steam generators (2.3.1.7)

The applicant described the results from the AMR for the Class 1 portions of the RCS, including the Class 1 piping, valves and pumps, reactor vessel, reactor vessel internals, in-core instrumentation system, pressurizer, and SGs in LRA Section 3.1, "Aging Management of Reactor Vessel, Internals, and Reactor Coolant System." LRA Table 3.1-1, "Summary of Aging Management Programs for the Reactor Coolant System Evaluated in NUREG-1801 that are Relied on for License Renewal," summarizes the results from the AMR for these RCS components. The applicant described the applicable AMPs for these components in LRA Appendix B, "Aging Management Programs and Activities." This section of the SER presents the staff's review of the AMR results presented in LRA Section 3.1 including the mechanical components for all seven RCS subsystems identified above.

3.1.2.4.1 Reactor Coolant System

The reactor coolant system non-Class 1 components at VCSNS include the RCP oil collection system components, piping and tubing, and valve bodies. The piping and tubing include instrumentation tubing downstream of flow restrictors, piping downstream of Class 1 boundary valves, charging system and letdown piping outside of the Class 1 boundary valves, vent and drain piping connecting to the charging system RCP seal cooling piping, discharge piping from relief valves and pressure control valves, valve leak-off piping, and the RCP oil collection system. The piping downstream of Class 1 boundary valves includes piping connecting to the emergency core cooling system (ECCS) check valve testing system, test connection piping associated with the safety injection system, and sampling system piping.

<u>Summary of Technical Information in the Application</u>

The applicant identified the non-Class 1 RCS components within the scope of license renewal in LRA Section 2.3.1.1. In three different LRA sections (3.1, 3.2, and 3.3), the applicant described its AMPs process for non-Class 1 components and the aging management programs that will be used to manage aging effects in these components during the period of extended operation for VCSNS. This information is presented in LRA Tables 3.1-1, 3.1-2, 3.2-1, 3.2-2, 3.3-1, and 3.3-2, and is evaluated here.

The applicant identified the following TLAAs applicable to non-Class 1 piping in LRA Table 3.1-1:

- metal fatigue for ASME Section III
- class 2 and 3 piping fatigue

Aging Effects:

In LRA Tables 3.1-1 and 3.1-2, the applicant identified the following aging effects for the non-Class 1 RCS components that are subject to an AMR:

- loss of material
- crack initiation and growth

In LRA Table 3.1-2, the AMR results identify no aging effect for stainless steel (including CASS) non-Class 1 components exposed to moist or dry air environment, or deaerated distilled water.

Aging Management Programs:

In LRA Tables 3.1-1 and 3.1-2, the applicant identified that the Chemistry Program will manage the aging effects associated with the non-Class 1 RCS components that are subject to AMRs.

Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in Section 3.1, and in LRA Tables 3.1-1 and 3.1-2, and in pertinent sections of the LRA Appendices A and B regarding the applicant's demonstration that the effects of aging will be adequately managed so that the intended functions of the non-Class 1 RCS components will be maintained consistent with the CLB throughout the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Tables 3.1-1 and 3.1-2, the applicant listed the non-Class 1 RCS components within the scope of license renewal with their material groups and environment. The intended functions of these components are listed in LRA Table 2.3-1. In LRA Tables 3.1-1 and 3.1-2, the applicant also identified the aging effects requiring management and the plant-specific AMPs required for managing them during the period of extended operation. The components within the scope of license renewal are grouped according to component types.

In LRA Section 3.1, the applicant identifies the following TLAAs that are applicable to non-Class 1 RCS components:

- metal fatigue for ASME Section III
- Class 2 and 3 piping fatigue

The application of these TLAA is evaluated in Section 4.3 of this SER.

Aging Effects:

The material of construction for the non-Class 1 RCS components included in LRA Section 3.1 is primarily stainless steel (including CASS) for piping and piping system components and capillary tubes and associated components. These components are exposed to chemically treated borated water, treated water, and/or air-gas environments. The applicant performed a review of industry experience and NRC generic communications related to the non-Class 1 components to provide reasonable assurance that the aging effects that require management for a specific material-environment combination are the only aging effects of concern for VCSNS. This review also included a review of VCSNS plant-specific operating experience. LRA Tables 3.1-1 and 3.1-2 identify that loss of material and cracking are the only aging effects applicable to the non-Class 1 RCS components requiring AMRs and included in LRA Section 3.1.

Loss of material due to general corrosion is not normally an issue for austenitic stainless steel (including CASS) non-Class 1 RCS components because the materials are normally inherently

tough and resistant to general corrosion; however, loss of material may be an applicable effect for these components under wet conditions if the components have creviced areas that may be exposed to the fluids or have areas where stagnant fluid may be present. The applicant identified that loss of material is an applicable aging effect for all stainless steel non-Class 1 RCS components with interior surfaces exposed to borated or treated water environments. The staff finds this identification of loss of material as an aging effect acceptable because it accounts for loss of material that could be caused by pitting or crevice corrosion.

LRA Table 3.1-2, AMR Item 1, states that the stainless steel tubing and CASS valve bodies externally exposed to moist air environment have no aging effects requiring management. Similarly, LRA Table 3.3-1, AMR Item 6, states that there is no applicable aging effect for the stainless steel oil collection system components. The applicant stated that the VCSNS ambient environment does not contain contaminants of sufficient concentration to cause aging effects that require aging management. The staff issued an RAI 3.1.2.4.2-8, requesting the applicant to submit additional information supporting its determination that no aging effect requires management. In response to RAI 3.1.2.4.2-8, in a letter dated June 12, 2003, the applicant stated that VCSNS is located well inland and does not see salt or other corrosive materials in the air from agriculture or industry. The applicant further stated that moist air is not dry, but it is noncondensing for the oil collection components, as well as most other components. The review of operating experience at VCSNS has not identified any aging effects for these components. Therefore, the staff finds the applicant’s statement of no applicable aging effect to be acceptable for stainless piping, oil collection components, and CASS valve bodies exposed to moist air environment.

LRA Table 3.1-2, AMR Item 6, identifies crack initiation and growth as an aging effect for the non-Class 1 stainless steel pipe, orifices, tube and tube fittings, and valve bodies exposed to chemically treated borated coolant. The staff finds this identification of cracking as an applicable aging effect acceptable because stainless steel components exposed to the borated coolant are susceptible to crack initiation and growth, especially when the coolant temperature is greater than 93 °C (200 °F).

LRA Table 3.1-2, AMR Items 12 and 15, states that the stainless steel components exposed to deaerated distilled water or air-gas environment have no aging effects requiring management. This is acceptable because the environment to which these components are exposed does not contain moisture or contaminants that could cause corrosion damage.

LRA Table 3.2-2, AMR Item 4, states that the carbon steel and copper-nickel components exposed to lubricating oil have no aging effects requiring management. This is acceptable because these components are not subject to wetting and their surfaces always remain oil-coated because they are continuously in service.

LRA Table 3.3-1, AMR Item 14, states that the RCP thermal barrier flange that is exposed to treated water will have loss of material due to general, pitting, and crevice corrosion, and MIC, and thus require aging management. This determination is acceptable because this AMR result is consistent with the GALL Report.

Aging Management Programs:

The applicant identified the Chemistry Program in LRA Appendix B.1.4 for managing loss of material and cracking in stainless steel non-Class 1 RCS components. The staff's evaluation of this program is presented in Section 3.0.3 of this SER.

LRA Table 3.1-2, AMR Item 5, states that stainless steel non-Class 1 RCS components are internally exposed to chemically treated borated water and subject to loss of material due to crevice and pitting corrosion. The Chemistry Program, LRA Appendix B.1.4, is credited with managing this aging effect. These components include non-Class 1 orifices, pipe, tube, tube fittings, and valve bodies. The applicant states that the Chemistry Program is similar to GALL AMP XI.M2, except that it does not include a one-time inspection of selected components to verify the effectiveness of the program. In RAI B.1.4-1, the staff requested the applicant to explain why a one-time inspection is not needed to verify the absence of loss of material due to pitting and crevice corrosion. In its response to RAI B.1.4-1, in a letter dated June 12, 2003, the applicant stated that such inspections are not required because a review of VCSNS operating experience did not reveal a loss of intended function of components that are exposed to borated water. The staff finds the applicant's explanation acceptable because the effects of pitting and crevice corrosion on stainless steel components are not significant in chemically treated borated water. Therefore, inspection of selected components for verifying the absence of loss of material is not required.

LRA Table 3.1-2, AMR Item 6, states that stainless steel non-Class 1 RCS components are internally exposed to chemically treated borated water and subject to crack initiation and growth due to SCC; the Chemistry Program, LRA Appendix B.1.4, is credited with managing this aging effect. These components include non-Class 1 orifices, pipe, tube, tube fittings, and valve bodies. The applicant stated that the Chemistry Program is similar to GALL AMP XI.M2, except that it does not include a one-time inspection of selected components to verify the effectiveness of the program. In RAI B.1.4-1, the staff requested the applicant to explain why a one-time inspection is not needed to verify the absence of cracking due to SCC. In its response to RAI B.1.4-1, in a letter dated June 12, 2003, the applicant stated that such inspections are not required because a review of VCSNS operating experience did not reveal any cracking in components that are exposed to borated water. The staff finds the applicant's explanation acceptable. These chemistry related issues are discussed in Section 3.0.3.2 of this SER.

LRA Table 3.1-2, AMR Item 14, states that stainless steel piping and piping system components, including non-Class 1 pipe and valve bodies, are internally exposed to treated water from the reactor makeup water system for pressurizer relief tank spray. As a result, these components are subject to loss of material due to crevice and pitting corrosion, and the Chemistry Program, LRA Appendix B.1.4, is credited with managing this aging effect for these components. The applicant stated that the Chemistry Program is similar to GALL AMP XI.M2, except that it does not include inspection of selected components to verify the effectiveness of the program. The staff finds the applicant's explanation acceptable for not including inspection of selected components for verifying the absence of loss of material because the effects of pitting and crevice corrosion on stainless steel components are not significant in treated water.

According to LRA Table 3.3-1, AMR Item 14, the applicant credits the Chemistry Program (LRA Appendix B.1.4) for managing loss of material in RCP thermal barrier flange and piping in lieu of GALL AMP XI.M21. However, the Chemistry Program does not require inspection of the flange to determine whether loss of material due to corrosion is taking place, whereas the GALL AMP XI.M21 requires such inspection. The applicant stated that the Chemistry Program has

been in effect since initial plant startup and has been proven effective in maintaining system chemistry. The applicant further stated that a review of the operating experience confirmed the effectiveness of this program. Therefore, the staff finds that the applicant's use of the Chemistry Program alone is acceptable for managing loss of material in RCP thermal barrier flange and piping.

Conclusions

On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.4.2 Reactor Coolant Piping, Valves, and Pumps

The reactor coolant piping, valves, and pumps include Class 1 piping and valves, and reactor coolant pumps. The Westinghouse-supplied primary piping includes fittings, safe ends, branch connection nozzles, thermal sleeves, flow restrictors, and thermowells. The Class 1 portion of the RCS includes portions of the chemical and volume control system, emergency core cooling system, residual heat removal system, and safety injection system.

ASME Class 1 piping includes piping connected to the Westinghouse-supplied primary loop piping out to and including (1) the outermost containment isolation valve in piping which penetrates primary containment or (2) the second of two valves usually closed during normal reactor operation in piping which does not penetrate primary containment. Some branch connections and instrument connections in the RCS are equipped with 3/8 in. inside diameter (ID) flow restricting orifices that limit the maximum flow from a break downstream of the flow restrictor to below the makeup capability of the RCS. This orifice is used instead of double isolation valves to establish the division from Class 1 to Class 2.

For Class 1 valves, the pressure-retaining portion of the component consists of the valve body, bonnet, and closure bolting. The valves are welded in place with the exception of the pressurizer safety valves that have flanged connections. For the reactor coolant pumps, the pressure-retaining portion includes the pump casing, the main closure flange, the thermal barrier heat exchanger flange and piping, and the pressure-retaining bolting.

Summary of Technical Information in the Application

The applicant identified the Class 1 RCS piping, valves, and pumps within the scope of license renewal in LRA Section 2.3.1.2. In Section 3.1 of the application, the applicant described its AMR process for ASME Code Class 1 components and the AMPs that will be used to manage aging effects in these components during the periods of extended operation for VCSNS. In LRA Tables 3.1-1 and 3.1-2, the applicant identified that the following Class 1 RCS piping, valves, and pumps within the scope of license renewal require AMRs:

- Westinghouse-supplied primary loop Class 1 piping of the RCS pressure boundary that is connected to the reactor vessel, the SGs (primary side), and the reactor coolant pump

- Class 1 piping of other support systems that is attached to the primary loop piping

- pressure boundary portion of Class 1 valves (bodies and bonnets, bolting)

- pressure boundary portion of the RCP (casing, main closure flange, thermal barrier heat exchanger and bolting).

The applicant described its AMR of the Class 1 piping and associated components for license renewal in LRA Section 3.1.1 and in LRA Tables 3.1-1 and 3.1-2. The staff reviewed this LRA section to determine whether the applicant demonstrated that the effects of aging on the RC Class 1 piping, valves, and pump casings will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The applicant stated that the RCS Class 1 piping, valve, and pump components within the scope of license renewal have been designed to meet the requirements of ASME Boiler and Pressure Vessel Code, Section III, Subsection NB for Class 1 components. The predominant material of construction for the Class 1 components, including piping and pipe fittings, is stainless steel, including CASS. The internal surfaces of all Class 1 piping and associated components wetted by borated water are stainless steel. Some bolting and exterior surfaces of the pressure boundary components are identified as carbon or low-alloy steel. Design and welding considerations in the selection of materials for RCS components reduce the susceptibility of Class 1 piping and component materials to sensitization.

The Class 1 piping and associated components that are within the scope of license renewal are internally exposed to borated reactor coolant water at approximately 315.6 ^{o}C (600 ^{o}F) and 15.41 MPa (2235 psig). These components are located in the reactor building (i.e., containment) and are externally exposed to an air environment. External surfaces near mechanical piping connections (e.g., flanges) may also be exposed to borated water leakage. The thermal barrier heat exchangers for the RCPs are also exposed to treated water.

In LRA Section 4.0, the applicant identified the following three TLAAs applicable to RCS piping and associated components; only the first one is specifically identified in LRA Table 3.1.1:

Metal fatigue for ASME class 1 components
RCP flywheel fatigue
Leak-before-break analyses

Aging Effects:

In LRA Tables 3.1-1 and 3.1-2, the applicant identified the following aging effects for the RCS Class 1 piping and associated components that are subject to an AMR:

- cracking
- loss of material
- reduction in fracture toughness
- loss of preload

Aging Management Programs:

In LRA Tables 3.1-1 and 3.1-2, the applicant identified the following four AMPs to manage the aging effects associated with reactor coolant piping, valves, and pumps:

- Boric Acid Corrosion Surveillances
- Chemistry Program
- Inservice Inspection Plan
- Small Bore Class 1 Piping Inspection

The first three programs are existing, whereas the last one is a new program at VCSNS. The applicant concluded that these AMPs will manage the effects of aging such that the intended function of the RCS Class 1 piping and associated components will be maintained consistent with the CLB under all design-loading conditions throughout the period of extended operation, as required by 10 CFR 54.21(a)(3).

Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in LRA Section 3.1, Tables 3.1-1 and 3.1-2, and pertinent sections of LRA Appendices A and B regarding the applicant's demonstration that the effects of aging will be adequately managed so that the intended functions of the reactor coolant piping, valves, and pumps will be maintained consistent with the CLB throughout the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Tables 3.1-1 and 3.1-2, the applicant listed the reactor coolant piping, valves, and pumps within the scope of the license renewal with their material groups and environment. The intended functions of these components are listed in LRA Table 2.3-2. In the LRA tables, the applicant also identified the aging effects requiring management, and the plant-specific AMPs for managing them during the period of extended operation. The components within the scope of license renewal are grouped in according to their component types, and these groups are listed in these tables.

In LRA Section 4.0, the applicant identified the following three TLAAs applicable to reactor coolant piping and associated components:

- metal fatigue for ASME Class 1 components (Section 4.3)
- RCP flywheel fatigue (Section 4.7.1)
- leak-before-break analyses (Section 4.7.2)

Aging Effects:

In accordance with LRA Section 3.1, the applicant performed a review of industry experience, NRC generic communications, and VCSNS plant-specific operating experience related to the RCS Class 1 piping, valves, and pumps to present reasonable assurance that the aging effects that require management for a specific material-environment combination are the only aging effects of concern for VCSNS.

The material of construction for the RCS Class 1 piping, valves, and pumps subject to an AMR is primarily stainless steel (including CASS). Carbon steel and low-alloy steel are used for RCP main flange bolting. Most RCS piping and associated components are exposed to borated

water, treated water, and/or air. The applicant performed a review of industry experience and NRC generic communications related to the reactor coolant piping and associated components to provide reasonable assurance that the aging effects that require management for a specific material-environment combination are the only aging effects of concern for VCSNS. This review also included a review of VCSNS plant-specific operating experience. In LRA Tables 3.1-1 and 3.3-1, the applicant identified the following aging effects that are applicable to the RCS Class 1 piping, valves, and pumps requiring AMRs:

- loss of closure integrity of stainless steel and low-alloy steel bolting in the reactor building (i.e., air) environment

- loss of material for low-alloy steel bolting externally exposed to leaking borated coolant

- cracking of CASS RCS nozzles and elbows internally exposed to chemically treated borated coolant

- cracking of austenitic stainless steel small-bore RCS piping internally exposed to chemically treated borated coolant

- reduction in fracture toughness of CASS components (including valve bodies and bonnets, and RCP casings and main closure flanges) in a high temperature borated water environment

The applicant stated that the identification of the above aging effects in LRA Table 3.1-1 is consistent with the GALL Report, with one exception. For stainless steel and low-alloy steel bolting, the applicant identified loss of closure integrity, rather than loss of preload and cracking, as an aging effect requiring management. In RAI 3.1.2.4.2-1b, the staff requested the applicant to describe the difference between loss of closure integrity and the aging effects of cracking, loss of material, and loss of preload. In a response to RAI 3.1.2.4.2-1b, in a letter dated June 12, 2003, the applicant stated that loss of mechanical closure integrity can result in failure of the mechanical joint and is evidenced by leakage rather than joint failure. The applicant further stated that this failure of mechanical joint can be attributed to loss of bolt preload, loss of bolting material by wear, and cracking of high-strength bolting material. Therefore, loss of closure integrity includes the effects of loss of preload, loss of material, and cracking of bolting materials. The staff finds this explanation acceptable because, as discussed in Section 3.1.2.4.2, the management of loss of closure integrity also provides management of loss of preload, loss of material, and cracking of bolting material.

LRA Table 3.1-1, AMR Item 20, states that the CASS elbows and nozzles of the RCS Class 1 piping are not susceptible to loss of fracture toughness because these components have low molybdenum content and have delta ferrite levels of less than 20 percent. The staff finds this acceptable because the molybdenum content and the delta ferrite levels for these components meet the screening criteria set forth in a letter dated March 19, 2000, from Christopher Grimes, NRC, to Douglas Walters, NEI.

In LRA Table 3.1-1, AMR Item 24, the applicant identified the following discrepancy in the GALL Report (NUREG-1801). The NUREG-1801, Table 1 “Component” column presents an exception for cast stainless steel components (i.e., valve bodies and bonnets, and RCP pump

casings). However, the column entitled, “Item Number in GALL” includes these components. Therefore, the applicant has included the AMR results for these components in LRA Table 3.1-1, AMR Item 24. The staff has reviewed Table 1 and Table IV.C2 of the GALL Report and confirmed that the applicant’s finding is correct and that the applicant's AMR for these CASS components is consistent with GALL.

The austenitic stainless steel RCS piping is susceptible to SCC at the external surface if it comes in contact with halogens that may be present in the thermal insulation. The applicant, however, does not identify cracking as an aging effect at the external surface of these components. The staff issued RAI 3.1.2.4.2-3, requesting the applicant to submit a description of all insulation used on austenitic stainless steel RCS piping to ensure that the piping is not susceptible to stress-corrosion cracking from halogens. In response to RAI 3.1.2.4.2-3, in a letter dated June 12, 2003, the applicant stated that stainless steel reflective insulation is the most commonly used insulation type on stainless steel piping and components. Various other types of insulation used on stainless steel are encapsulated in stainless steel. The applicant further stated that, unlike fibrous insulation, the stainless steel does not need controls for halogens. The staff agrees with the applicant that the external surface of the stainless steel RCS piping is not susceptible to cracking due to SCC because VCSNS uses stainless steel insulation which does not contain halogens.

The staff reviewed NUREG-1801, Chapter IV.C2, “Reactor Coolant System and Connected Lines,” and confirmed that the applicant's identification of the aging effects for RCS Class 1 piping, valves, pumps, and closure bolting in Table 3.1-1 is consistent with the GALL Report, and therefore acceptable.

In Table 3.1-2, the applicant identified the following additional aging effect for Class 1 RCS piping:

- loss of material in stainless steel components (including CASS) internally exposed to chemically treated borated coolant

The stainless steel components are inherently tough and resistant to general corrosion; however, loss of material due to crevice and pitting corrosion may be an applicable effect for these components under wet conditions, especially if the components have creviced areas that may be exposed to the fluids. Therefore, the applicant's identification of loss of material as an aging effect for stainless steel components internally exposed to chemically treated borated coolant is acceptable because it conservatively accounts for loss of material that could be induced by these corrosion mechanisms, even though these components do not have creviced regions.

LRA Table 3.1-2, AMR Item 1, states that the stainless steel piping (including CASS) exposed to a moist air environment is not susceptible to any aging effect requiring management. The staff finds this acceptable because the stainless steel components are resistant to general corrosion and the ambient environment at VCSNS does not contain contaminants of sufficient concentration to cause any aging effect requiring management.

The aging effects identified in the LRA for the Class 1 portion of the RCS piping, valves, and pumps are consistent with industry operating experience for the materials and environments

listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs:

In LRA Tables 3.1-1 and 3.1-2, the applicant identified the following four AMPs to manage the aging effects associated with reactor coolant piping, valves, and pumps:

- Boric Acid Corrosion Surveillance Program
- Chemistry Program
- Inservice Inspection Plan
- Small Bore Class 1 Piping Inspection

The Boric Acid Corrosion Surveillance program (LRA Section B.1.2) was developed by the applicant in response to NRC GL 88-05. Inspections are performed to present reasonable assurance that borated water leakage from the reactor coolant pressure boundary does not lead to undetected loss of material on the external surface of carbon steel or low-alloy steel bolting. The staff has evaluated this common AMP and found it to be acceptable for managing the aging effect of loss of material identified for the RCS pressure boundary closure bolting. The staff's evaluation of this AMP is documented in Section 3.0.3.1 of this SER.

According to LRA Table 2.3-2, AMR Item 6 of LRA Table 3.1-1 and AMR Item 6 of LRA Table 3.1-2 present the results for austenitic stainless steel piping and fittings (less than NPS 4) and orifices exposed to chemically treated borated coolant. Both AMR items identify the same aging effect (i.e., cracking) but different AMPs. AMR Item 6 of LRA Table 3.1-1 credits three programs, the Chemistry Program (LRA Appendix B.1.4), the ISI Plan, (LRA Appendix B.1.7), and the Small Bore Class 1 Piping Inspections (LRA Appendix B.2.7) for managing cracking. However, AMR Item 6 of LRA Table 3.1-2 credits only one program, the Chemistry Program (LRA Appendix B.1.4), for managing cracking. The staff issued RAI 3.1.2.4.2-6, requesting the applicant to explain this apparent discrepancy. In its response to RAI 3.1.2.4.2-6, in a letter dated June 12, 2003, the applicant stated that Table 3.1-1, Item 6, includes only Class 1 piping, whereas Table 3.1-2, Item 6, includes thermocouple seals, reactor coolant tubing and fittings, RCP thermal barrier flange, and non-Class 1 piping. The applicant asserted that the Chemistry Program alone is adequate for managing cracking in these stainless steel, non-Class 1 piping components. The applicant supported its assertion by referring to GALL, Chapter V, which states that the Chemistry Program alone can be acceptable AMP for crack initiation and growth for stainless steel components.

The staff's review of GALL, Chapter V revealed that GALL has accepted the Chemistry Program alone for managing cracking in the stainless steel components exposed to chemically treated borated coolant because the coolant temperature is less than 93 °C (200 °C); below this temperature, stainless steel has significantly low susceptibility to cracking due to SCC. Therefore, the staff accepts the applicant's use of the Chemistry Program alone for managing cracking in the stainless steel components, provided that these components are exposed to borated coolant at a temperature less than 93 °C. Otherwise, the use of the Chemistry Program alone is not adequate for managing cracking on the inside surface of the non-Class 1 stainless steel components, and the applicant needs to provide a program to verify that cracking is not occurring on the inside surface of these components. These chemistry related issues are discussed in Section 3.0.3.2 of this SER.

The applicant credited the ISI Plan (LRA Section B.1.7) and the Chemistry Program (LRA Section B.1.4) for managing crack initiation and growth in the RCS Class 1 austenitic stainless steel piping, CASS elbows and nozzles, and CASS valve bodies and pump casings. The staff evaluations of the ISI Plan and Chemistry Program are documented in Sections 3.1.2.3.3 and 3.0.3.2, respectively, of this SER. The scope of the ISI Plan for the Class 1 components complies with the requirements of ASME Section XI, Subsection IWB. Depending on the examination category, the methods of inspection may include visual, surface, and/or volumetric examination of the welded portion of the components susceptible to aging degradation. The staff finds the use of the ISI Plan and Chemistry Program for managing cracking in Class 1 stainless steel components acceptable because the operating experience indicates that these programs have been effective in managing cracking in stainless steel components.

The applicant credited the ISI Plan (LRA Appendix B.1.7) for managing loss of closure integrity in the RCS Class 1 closure bolting, including RCP main flange bolting. In RAI 3.1.2.4.2-1a, the staff requested the applicant to explain how the management of loss of closure integrity by the ISI Plan would ensure that the intended function of the bolted joint would be maintained during the extended period of operation. In response to RAI 3.1.2.4.2-1a, in a letter dated June 12, 2003, the applicant stated that the management of the loss of closure integrity with the ISI Plan includes surface and volumetric examinations for detecting cracking and loss of material in bolts and nuts during each inspection interval or when a closure is disassembled. When closure bolting is disassembled, retorquing of the bolting during reassembly establishes the desired preload. Thus, any loss of preload that might have occurred during previous operation would be removed when a closure bolting is disassembled and then reassembled. The staff accepts the applicant's response because the applicant's management of loss of mechanical closure integrity with the ISI Plan is adequate for managing the aging effects of loss of material, cracking, and loss of preload. Therefore, it ensures that the intended function of the closure bolting would be maintained during the extended period of operation.

The NRC IN 2000-17, "Crack in Weld Area of Reactor Coolant System Hot Leg Piping at V.C. Summer," reports a through-wall crack in Alloy 182/82 weld between the A hot-leg nozzle and stainless steel piping caused by PWSCC. The applicant described this event as operating experience in LRA Appendix B.1.1, Alloy 600 AMP. A spool piece was used to replace the affected weld and was installed using Alloy 52 and 152 weld materials, in effect removing the susceptible material. The applicant also reported that further inspection of the other RCS nozzle safe end-to-pipe welds detected minor indications of cracking in B and C hot-leg nozzles. The staff issued RAI 3.1.2.4.2-4 to confirm whether the Alloy 600 AMP is credited for managing PWSCC cracking in Alloy 82/182 welds in RCS Class 1 piping. This RAI was discussed during a June 22, 2003, conference call. In response, the applicant stated that aging management of ASME Class 1 dissimilar welds (Alloy 82/182 welds) is within the scope of LRA Appendix B.1.1, Alloy 600 AMP. The staff finds the response acceptable because it is consistent with the AMR results presented in LRA Table 3.1-1.

In RAI 3.1.2.4.2-4, the staff also requested the applicant to identify any mitigative actions taken since the submittal of the LRA to minimize the growth of existing PWSCC cracks in B and C hot-leg nozzles. In response to RAI 3.1.2.4.2-4, in a letter dated June 12, 2003, the applicant stated that VCSNS has implemented a mechanical stress improvement process (MSIP) for the B and C hot-leg nozzles that were not repaired. The applicant further stated that because of the application of MSIP, the leak-before-break analysis does not need to be revised. For further information, the applicant referred to a letter from K.R. Cotton (NRC) to S.A. Bryan,

"Safety Evaluation of Flaws Detected in V. C. Summer Nozzle-to-Pipe Welds in the Hot Legs of Loops B and C (TAC No. MB4870)," October 1, 2002. The letter states that the application of MSIP has reduced the VCSNS plant-specific PWSCC crack growth rate and the driving force for the cracks has been either eliminated or greatly reduced. The applicant plans to perform inspection of the nozzles during the next refueling cycle (RF-14) and submit the inspection results to the staff for review so that the adequacy of the applicant's future inspection plans for the detected flaws can be assessed. The applicant's approach for managing the detected flaws in the two hot-leg nozzle-to-piping welds is acceptable because it will be reviewed and approved by the staff.

The Chemistry Program (LRA Appendix B.1.4) references water quality that is compatible with the materials of construction used in the Class 1 piping and associated components in order to minimize loss of material and cracking. This program incorporates EPRI and Institute of Nuclear Power Operations (INPO) guidelines, which reflect industry experience, and the "lessons learned" from VCSNS and external industry operating experience. However, the applicant does not identify any specific document for the water chemistry guidelines. The GALL AMP XI.M2, "Water Chemistry," refers to EPRI TR-105714, :PWR Primary Water Chemistry Guidelines—Revision 3." In RAI 3.1.2.4.2-5, the staff requested the applicant to confirm whether the Chemistry Program incorporates the guidelines in EPRI TR-105714, Revision 3 or a later revision. In its response to RAI 3.1.2.4.2-5, dated June 12, 2003, the applicant stated that the VCSNS Chemistry Program incorporates the guidelines of EPRI TR-105714, Revision 4. Although the applicant follows the guidelines of Revision 4 instead of Revision 3 of the EPRI report, the staff finds the applicant's response acceptable because Revision 4 accounts for the industry experience since the publication of Revision 3.

In LRA Table 3.1-2, AMR Items 5 and 7, the applicant credited the Chemistry Program (Section B.1.4) for managing loss of material in the austenitic stainless steel components (including CASS). This is adequate because the stainless steel components are inherently tough and resistant to general corrosion. As stated in Section 3.1.2.4.2 of the SER, these components under wet conditions could experience loss of material due to pitting and crevice corrosion, especially if the components have creviced areas exposed to the fluids. The staff issued RAI B.1.4-1, requesting the applicant to explain why a one-time inspection is not needed for verifying the absence of loss of material due to pitting and crevice corrosion. In response to RAI B.1.4-1, in a letter dated June 12, 2003, the applicant stated that such inspections are not required because a review of VCSNS operating experience did not reveal a loss of intended function of components that are exposed to borated water. In addition, these stainless steel components do not have creviced regions. The staff finds the applicant's explanation acceptable for not including inspection of selected components to verify the absence of loss of material because the effects of pitting and crevice corrosion on stainless steel components are not significant in chemically treated borated water.

The applicant proposed a new program, the Small Bore Class 1 Piping Inspections Program, along with two existing programs, the Chemistry Program and ISI Plan, to manage cracking of the small-bore Class 1 RCS piping. The staff's evaluation of the adequacy of these three programs for managing cracking of the small-bore Class 1 RCS piping is presented in Section 3.1.2.2.6 of this SER.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the Class 1 portion of the RCS piping, valves, and pumps will effectively manage or monitor the aging effects identified in the LRA.

Conclusions

On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.4.3 Reactor Vessel

The VCSNS vessel, fabricated by Chicago Bridge and Iron, Inc., is cylindrical, with a welded hemispherical bottom head and a removable, bolted, flanged, and gasketed, hemispherical upper head. The reactor vessel flange and head are sealed by two hollow metallic O-rings. Seal leakage is detected by means of two leakoff lines. The vessel contains the core, core support structures, control rods, and other parts directly associated with the core. The reactor vessel closure head contains adapters for connecting the control rod drive mechanisms (CRDM) and instrumentation. The vessel has an inlet and an outlet nozzle for each of the three primary piping loops located just below the flange. Coolant enters through the inlet nozzles, flows down the core barrel-vessel annulus, turns at the bottom and flows through the core to the outlet nozzles. Inlet and outlet nozzles are located symmetrically around the vessel. The bottom head of the vessel contains penetration nozzles for connection and entry of the nuclear in-core instrumentation.

The reactor vessel is classified as a Class 1 component and, therefore, the design and fabrication of the vessel was carried out in accordance with ASME Code, Section III, Class 1 requirements. The use of sensitized stainless steel as a pressure boundary material was eliminated by either a choice of material or by programming the method of assembly. The carbon/low-alloy steel vessels are clad on their internal surfaces with austenitic stainless steel to prevent the carbon/low-alloy steel materials from being in direct contact with the primary coolant.

The cylindrical portion of the VCSNS reactor vessel is made of several shells, each consisting of formed plates joined by full penetration, longitudinal and circumferential welds. The hemispherical heads are made from dished plates. The vessel flange, nozzles, and nozzle safe ends are made of forgings. The vessel plates and forgings are joined by welding.

LRA Section 2.3.1.3 and UFSAR Section 5.4.2 describe the VCSNS reactor vessel and its appurtenances.

Summary of Technical Information in the Application

The applicant describes its AMR of the reactor vessel in LRA Section 3.1, “Aging Management of Reactor Vessel, Internals, and Reactor Coolant System.” The staff reviewed this section of the LRA to determine whether the applicant has demonstrated that the effects of aging on the reactor vessel and its appurtenances will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Fourteen component groups are listed in LRA Tables 3.1-1 and 3.1-2. They include shell components, nozzles, head penetrations, and CRDM housings. The intended function of all of these components is to provide the pressure boundary. The reactor vessel core support pads support the reactor vessel internals.

Aging Effects:

In LRA Tables 3.1-1 and 3.1-2, the applicant identifies the following aging effects for the reactor vessel and its appurtenances that are subject to an AMR:

- cracking
- loss of material
- loss of fracture toughness
- loss of closure integrity

Aging Management Programs:

In LRA Tables 3.1-1 and 3.1-2, the applicant identifies the following six existing AMPs to manage the aging effects associated with reactor vessel and its appurtenances:

- boric acid corrosion surveillance program
- chemistry program
- Inservice inspection plan
- reactor vessel surveillance program
- alloy 600 aging management program
- reactor head closure studs program

The applicant concluded that these AMPs will manage the effects of aging such that the intended function of the reactor vessel and its appurtenances will be maintained consistent with the CLB under all design loading conditions throughout the period of extended operation, as required by 10 CFR 54.21(a)(3).

The applicant does not specifically identify any TLAAs in Section 3.1 of the LRA that is applicable to reactor vessel and its appurtenances. However, Section 4.0 of the LRA includes the following TLAAs applicable to the reactor pressure vessel and its appurtenances:

- reactor vessel neutron embrittlement (Section 4.2 of the LRA)
- metal fatigue (Section 4.3 of the LRA)

The staff's evaluations of these TLAAs are presented in Sections 4.2 and 4.3, respectively, of this SER.

<u>Staff Evaluation</u>

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in LRA Section 3.1, Tables 3.1-1 and 3.1-2, and the pertinent sections of LRA Appendices A and B, regarding the applicant's demonstration that the effects of aging will be adequately managed so that the intended function(s) of the reactor vessel will be maintained consistent with the CLB throughout the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Tables 3.1-1 and 3.1-2, the applicant lists the reactor vessel and its appurtenances within the scope of the license renewal with their material groups and environment. The intended functions of these components are listed in LRA Table 2.3-3. In the LRA tables, the applicant also identifies the aging effects requiring management and the plant-specific AMPs required to manage these aging effects during the period of extended operation. The components within the scope of license renewal are grouped in accordance with their component types, and these groups are listed in these tables.

In LRA Section 4.0, the applicant identifies the following two TLAAs applicable to the reactor vessel and its appurtenances:

- reactor vessel neutron embrittlement (Section 4.2)
- metal fatigue (Section 4.3)

Aging Effects:

In accordance with LRA Section 3.1, the applicant has performed a review of industry experience and NRC generic communications relative to the reactor vessel and its appurtenances to present reasonable assurance that the aging effects that require management for a specific material-environment combination are the only aging effects of concern for VCSNS. This also included the plant-specific operating experience at VCSNS.

The materials of construction for the reactor pressure vessel and its appurtenances subject to an AMR are low-alloy steel for vessel shell, closure head, bottom head, and flange (including stainless steel cladding); carbon steel or low-alloy steel for vessel support; stainless steel for CRDM housings; Alloy 600 for head penetrations and reactor vessel core support pads; and high-strength low-alloy steel for reactor vessel closure studs. The inside surface of reactor vessel components are exposed to borated water and the external surfaces of reactor vessel components are exposed to air. In LRA Table 3.1-1, the applicant identifies the following aging effects applicable to the reactor vessel and its appurtenances requiring an AMR:

- loss of fracture toughness for low-alloy steel reactor vessel beltline shell and welds internally exposed to chemically treated borated coolant

- cracking of stainless steel reactor vessel nozzle safe ends and CRD housings, and cladding on low-alloy steel vessel shell, heads and nozzles exposed to chemically treated borated coolant

- cracking of Alloy 600 closure head and bottom head penetrations, and core support pads exposed to chemically treated borated coolant

- loss of closure integrity of high strength low alloy reactor vessel closure studs exposed to containment environment (i.e., air)

- loss of material due to wear of reactor vessel flange, closure studs and core support pads

loss of material in low alloy steel reactor vessel shell and heads, carbon steel vessel support and closure studs exposed to leaking borated coolant

The applicant states that the identification of the above aging effects in LRA Table 3.1-1 is consistent with the GALL report. In LRA Table 3.1-1, AMR Item 7, the applicant states that the vessel shell materials at VCSNS do not include ASME SA-508, Class 2 material, which is susceptible to underclad cracking if the cladding was deposited on it with a high-heat input welding process. Since the VCSNS vessel shell does not include ASME SA-508, Class 2 material, it is not susceptible to underclad cracking. However, as discussed in Section 3.1.2.2.7 of this SER, the vessel flange and nozzle forgings are made of ASME SA 508, Cl2 material. The underclad cracking is not an applicable aging effect for these forgings because the high-heat input welding processes affecting underclad cracking were not used for application of cladding to these components. The staff accepts that underclad cracking is not an applicable aging effect for the VCSNS vessel components made of ASME SA-508, Class 2 material because the high-heat input welding processes were not used for application of cladding to these components.

LRA Table 3.1-1, AMR Item 9, represents the AMR results for various Ni alloy components except CRD nozzles exposed to the chemically treated borated coolant. The applicant states that at VCSNS, only, the core support pads and bottom head penetration tubes are included in this item. The applicant identifies crack initiation and growth due to PWSCC as an applicable aging effect for these components. The staff finds this identification acceptable because it is consistent with industry experience.

In LRA Table 3.1-1, AMR Item 18, the applicant states that for closure studs, the aging effect requiring management is loss of closure integrity rather than cracking. The staff has evaluated the management of aging effects for reactor vessel closure studs in Section 3.1.2.3.4 and determined that management of loss of closure integrity includes the management of cracking of closure studs.

In LRA Table 3.1-1, AMR Item 22, the applicant states that loss of material due to wear is not considered a valid aging effect for the control rod drive flange bolting requiring management. This statement implies that VCSNS has installed control rod drive flange bolting. However, Section 5.4.2 of the VCSNS UFSAR states that the upper ends of the CRD nozzles have a welded flexible canopy seal and not bolting. The staff issued RAI 3.1.2.4.3-2, requesting the applicant explain this discrepancy. In response to RAI 3.1.2.4.3-2, in a letter dated June 12, 2003, the applicant states that the VCSNS CRD nozzles are seal welded to the CRDMs. Therefore, the pressure boundary is not a bolted connection. The applicant further states that bolts are used for the magnetic housings; however, they do not constitute pressure boundary and are not in scope. Therefore, the staff finds the applicant’s clarification acceptable because it is consistent with the design of the Westinghouse plants where the upper end of the CRD nozzles are welded to the flexible canopy seal.

LRA Table 2.3-3 refers to LRA Table 3.1-1, AMR Item 28, for the AMR results for the reactor vessel closure studs assembly. However, LRA Table 3.1-1, AMR Item 28, presents the AMR results for vessel and vessel closure head flanges and not for closure studs assembly. The

staff issued RAI 3.1.2.4.3-3, requesting the applicant to explain this discrepancy. In response to RAI 3.1.2.4.3-3, in a letter dated June 12, 2003, the applicant states that the reactor vessel closure studs are not included in Table 3.1-1, Item 28. The staff finds the response acceptable because it is consistent with GALL.

The staff has reviewed NUREG-1801 Chapter IV.A2, Reactor Vessel, and confirmed that the applicant's identification of the aging effects in Table 3.1-1 for the reactor vessel and its appurtenances is consistent with the GALL report, except for the discrepancies noted in SER Table 3.1-1, and therefore acceptable.

LRA Table 3.1-2, AMR Items 1 and 2, state that the stainless steel CRD housings, Alloy 600 vessel closure head and bottom head penetrations, and Alloy 82/182 welds between the vessel nozzle safe ends and main coolant loop piping are exposed to moist air environment. These components are not susceptible to any aging effects requiring management. This is acceptable because the stainless steel and Ni-alloy based components are resistant to general corrosion and the ambient environment at VCSNS does not contain contaminants of sufficient concentration to cause an aging effect requiring management.

In Table 3.1-2, AMR Item 7, the applicant identifies loss of material as an aging effect for stainless steel and Ni-alloy components attached to the reactor vessel.

The stainless steel components are inherently tough and resistant to general corrosion; however, loss of material due to crevice and pitting corrosion may be an applicable aging effect for these components under wet conditions, especially if the components have creviced areas that may be exposed to the fluids. Therefore, the applicant's identification of loss of material as an aging effect for stainless steel components internally exposed to chemically treated borated coolant is acceptable.

LRA Table 2.3-3 refers to LRA Table 3.1-1, AMR Item 23, and LRA Table 3.1-2, AMR Item 11, for AMR results for Alloy 600 reactor vessel closure head penetration tubes. Both AMR Items address cracking as an aging effect for these tubes. AMR Item 23 proposes the Alloy 600 aging management program whereas AMR Item 11 proposes the chemistry program. The staff issued RAI 3.1.2.4.3-5, requesting the applicant to explain this discrepancy. In response to RAI 3.1.2.4.3-5, in a letter dated June 12, 2003, the applicant states that LRA Table 3.1-2, Item 11, should not be referenced in LRA Table 2.3-3 for RV closure head penetration tubes. The staff finds this explanation acceptable because it is consistent with the AMR results presented in the LRA.

The austenitic stainless steel and Ni-alloy based reactor vessel appurtenances (i.e., CRD housings, vessel head penetrations, and Alloy 82/182 welds) are susceptible to stress corrosion cracking at the external surface if they come in contact with halogens that may be present in the thermal insulation. The applicant has not identified cracking as an aging effect at the external surface of these components. The staff issued RAI 3.1.2.4.3-4, requesting the applicant to submit a description of all insulation used on austenitic stainless steel RCS piping to ensure that the reactor vessel appurtenances are not susceptible to stress-corrosion cracking from halogens. In response to RAI 3.1.2.4.3-4, in a letter dated June 12, 2003, the applicant states that stainless steel reflective insulation is the most commonly used insulation type on stainless steel piping and components. Various other types of insulation used on stainless steel are encapsulated in stainless steel. The applicant further states that unlike

fibrous insulation, stainless steel does not need controls for halogens. The staff agrees with the applicant that the external surface of the stainless steel and Ni-alloy based reactor vessel appurtenances is not susceptible to cracking due to halogen induced SCC, because VCSNS uses stainless steel insulation, which does not contain halogens. However, the external surfaces of these materials have cracked due to SCC and are discussed in Bulletins 2001-1, 2002-1, and 2002-2. Cracking due to SCC of these materials is managed by the Alloy 600 aging management program.

The AMR results for the PWR reactor vessel leak detection line (GALL Item IV.A2.1-f) are presented in Table 1 of NUREG-1801. Therefore, AMR Item 9 in LRA Table 3.1-1 should also include these AMR results. The staff issued RAI 3.1.2.4.3-6, requesting the applicant to confirm whether the AMR results for the reactor vessel leak detection line are included in LRA Table 3.1-1, AMR Item 9. In response to RAI 3.1.2.4.3-6, in a letter dated June 12, 2003, the applicant states that the reactor vessel flange leak detection line components are classified as Code Class 2 components and the corresponding AMR results for these components are presented in LRA Table 3.1-2, Items 1, 5, and 6. The applicable aging effects are loss of material and cracking at the inside surface of the line. The staff finds the response acceptable because stainless steel components are susceptible to loss of material due to crevice and pitting corrosion and cracking due to SCC when exposed to chemically treated borated coolant.

The aging effects identified in the LRA for the reactor vessel and its appurtenances are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs:

In LRA Tables 3.1-1 and 3.1-2, the applicant has identified the following six AMPs for managing the aging effects associated with reactor vessel and its appurtenances:

- boric acid corrosion surveillance program
- chemistry program
- Inservice inspection plan
- reactor vessel surveillance program
- alloy 600 aging management program
- reactor head closure studs program

The boric acid corrosion surveillance program (LRA Section B.1.2) was developed by the applicant in response to NRC Generic Letter 88-05. Inspections are performed to present reasonable assurance that borated water leakage from the reactor coolant pressure boundary does not lead to undetected loss of material on the external surface of carbon steel or low alloy steel bolting. The staff has evaluated this common AMP and found it to be acceptable for managing the aging effect of loss of material identified for the RCS pressure boundary closure bolting. The staff's evaluation of this AMP is documented in Section 3.0.3.1 of this SER. The evaluation of this AMP, as it is applied for managing PWSCC cracking in the reactor vessel closure head penetrations, is presented in Section 3.1.2.3.1 of this SER.

The applicant credits the Inservice inspection plan (LRA Section B.1.7), the chemistry program (LRA Section B.1.4), and the Alloy 600 aging management program (LRA Section B.1.1) for

managing aging effect of cracking in core support pads and bottom head penetration tubes. The staff's evaluation of these AMR results is presented in Section 3.1.2.2.9 of this SER and concluded that the three programs proposed by the applicant will adequately manage cracking in core support pads and bottom head penetrations.

The applicant also credits the Inservice inspection plan (LRA Section B.1.7), the chemistry program (LRA Section B.1.4), and the Alloy 600 aging management program (LRA Section B.1.1) for managing the aging effects of cracking due to SCC and PWSCC in stainless steel and Ni –alloy components including the CRDM housings and vent plugs; cladding on the closure head, flanges, and bottom heads; and safe ends. The applicant states that the ISI plan provides condition monitoring for weld regions, whereas chemistry program provides management of cracking in non-welded regions of stainless steel components. The staff finds this acceptable because the ISI plan includes inspections of the welds and the adjacent heat affected zones. Cracking due to SCC takes place in the heat-affected zones of the weld regions. The staff presented its evaluation of the Alloy 600 aging management program in Section 3.1.2.3.1 of this SER and concluded that the alloy 600 aging management program will effectively manage cracking in the Ni-alloy components.

The applicant credits the Inservice inspection plan (LRA Section B.1.7) for managing loss of material in the reactor vessel closure head and vessel flanges. The staff has evaluated this AMP and found it to be acceptable for managing the aging effects identified for the reactor vessel and its appurtenances. The staff's evaluation of this AMP is documented in Section 3.1.2.3.3 of this SER.

The chemistry program (LRA Appendix B.1.4) references water quality that is compatible with the materials of construction used in the Class 1 components in order to minimize loss of material and cracking. This program incorporates Electric Power Research Institute (EPRI) and Institute of Nuclear Power Operations (INPO) guidelines, which reflect industry experience, and the "lessons learned" from VCSNS and external industry operating experience. The staff has evaluated this common AMP and found it to be acceptable for managing the aging effects identified for the reactor vessel and its appurtenances. The staff's evaluation of this AMP is documented in Section 3.0.3.2 of this SER.

The chemistry program (LRA Section B.1.4) manages loss of material in stainless steel and Ni-alloy reactor vessel components (i.e., CRD housings, cladding, vent plug, bottom head and closure head penetration tubes, reactor vessel core support pads, and nozzle safe ends) internally exposed to chemically treated borated coolant. The staff finds the use of the chemistry program, alone, acceptable for managing loss of material in stainless steel and Ni-alloy components because these components have good resistance against pitting and crevice corrosion and it is consistent with GALL.

As mentioned in Section 3.1.2.4.3 of this SER, the applicant in response to RAI 3.1.2.4.3-6, states that loss of material and cracking are the applicable aging effects for the PWR reactor vessel flange leak detection line if exposed to chemically treated borated coolant. The applicant, however, further states that at VCSNS the leak detection line is monitored and found to remain dry. Therefore, management of cracking and loss of material in the leak detection line is not required because these aging effects are not present. The staff accepted that the leak detection line does not need management for loss of material or cracking as long as the line is monitored for leakage and it is found to remain dry. By letter dated September 24, 2003,

the applicant indicated that the reactor vessel flange leak detection components are classified as Code Class 2 components and are not normally filled with borated water. In addition, the applicant stated that the leak detection line connects between the two vessel o-rings to allow for monitoring of vessel o-ring leakage. The applicant confirmed that vessel o-ring leakage had not been a problem at VCSNS and the line has been dry during normal plant operations. Also, an alarm exists on the main control board to identify leakage and there are preplanned actions associated with the main control board alarms that include isolation of the line to contain the RCS leakage. If leakage is detected during plant operation, the applicant will follow its Corrective Action Program.

The reactor vessel surveillance program (LRA Section B.1.24) manages loss of fracture toughness in the reactor vessel beltline materials. The staff has evaluated this AMP and found it to be acceptable for managing loss of fracture toughness in the reactor vessel beltline materials. The staff's evaluation of this AMP is documented in Section 3.1.2.3.6 of this SER.

The Alloy 600 aging management program (LRA Section B.1.1) and the chemistry program (LRA Section B.1.4) manage cracking in the Alloy 600 vessel closure head penetrations. The staff has evaluated this AMP and found it to be acceptable for managing cracking in Alloy 600 vessel closure head penetrations. The staff's evaluation of this AMP is documented in Section 3.1.2.3.1 of this SER. As mentioned earlier in this section, the Alloy 600 aging management program also manages cracking in core support pads, bottom head penetration tubes, and safe ends, i.e., Alloy 82/182 welds at the ends of the safe ends.

The reactor vessel closure studs program (LRA Section B.1.8) manages loss of closure integrity and loss of material in the reactor vessel closure stud assemblies. The staff has evaluated this AMP and found it to be acceptable for managing loss of closure integrity and loss of material in the reactor vessel closure stud assemblies. The staff's evaluation of this AMP is documented in Section 3.1.2.3.4 of this SER.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the reactor vessel and its appurtenances will effectively manage or monitor the aging effects identified in the LRA.

Conclusions

On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.4.4 Reactor Vessel Internals

The components of the reactor vessel internals are divided into three parts, consisting of the lower core support structure (including the entire core barrel and neutron shield pad assembly), the upper core support structure, and the in-core instrumentation support structure. The reactor internals perform the following functions:

- provide core support
- maintain fuel alignment

- limit fuel assembly movement
- maintain alignment between fuel assemblies and control rod drive mechanisms
- direct coolant flow past the fuel elements
- direct coolant flow to the pressure vessel head
- provide gamma and neutron shielding
- provide guides for the in-core instrumentation

The coolant flows from the vessel inlet nozzles, down the annulus between the core barrel and the vessel wall, and then into a plenum at the bottom of the vessel. It then reverses and flows up through the core support and through the lower core plate. The lower core plate is sized to provide the desired inlet flow distribution to the core. After passing through the core, the coolant enters the region of the upper support structure and then flows radially to the core barrel outlet nozzles and directly through the vessel outlet nozzles.

Summary of Technical Information in the Application

The description of the reactor vessel internals can be found in LRA Section 2.3.1.4. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3-4. The components, aging effects, and aging management programs are discussed in Section 3.1 of the LRA, and are listed in LRA Tables 3.1-1 and 3.1-2. The staff reviewed Section 3.1 of the LRA to determine whether the applicant had demonstrated that the effects of aging on the RV internals will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

All of the major RV internals are fabricated from Type 304 stainless steel except for (a) the bolts and dowel pins, which are fabricated from Type 316 stainless steel; (b) the radial support key bolts, which are fabricated from Alloy X-750; and (c) the radial support clevis inserts and clevis insert bolts, which are fabricated from Alloy 600. There are no cast austenitic stainless steel (CASS) RV internal components within the scope of license renewal.

The RV internals that are within the scope of license renewal are exposed to borated reactor coolant water at approximately 315.6 °C (600 °F) and 15.41 MPa (2235 psig). These components are all located within the reactor pressure vessel.

Aging Effects:

In LRA Tables 3.1-1 and 3.1-2, the applicant identifies the following applicable aging effects for the RV internal components subject to an AMR:

- loss of fracture toughness
- changes in dimension
- crack initiation and growth
- loss of preload
- loss of material

As previously noted in Section 3.1.2.2.7 of this SER, the applicant states that, with respect to changes in dimensions due to void swelling, industry activities are under way to determine whether this is an aging effect requiring management for license renewal, and, if necessary, to

develop and qualify methods for detection and management. The applicant proposes to monitor these activities and implement the resulting methods, as necessary.

Aging Management Programs:

In LRA Tables 3.1-1 and 3.1-2, the applicant identifies the following two AMPs to manage the aging effects associated with RV internals:

- reactor vessel internals inspection program
- chemistry program

The reactor vessel internals inspection program is a new program developed by the applicant to manage the aging effects impacting the RV internals. It supplements the applicant's existing in-service inspection plan. The chemistry program is credited with managing the aging effects of several components in different structures and systems and is, therefore, considered a common aging management program. The applicant concluded that these two AMPs will manage the effects of aging such that the intended function of the reactor vessel internal components will be maintained consistent with the CLB under all design loading conditions throughout the period of extended operation, as required by 10 CFR 54.21(a)(3).

LRA Section 4.0 and Table 3.1.1 identify metal fatigue of Class 1 components as the only TLAA applicable to RV internals.

Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in Section 3.1, and in LRA Tables 3.1-1 and 3.1-2 and pertinent sections of the LRA Appendices A and B, regarding the applicant's demonstration that the effects of aging will be adequately managed so that the intended function(s) of the reactor vessel internal components will be maintained consistent with the CLB throughout the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Tables 3.1-1 and 3.1-2, the applicant lists the reactor vessel internal components within the scope of the license renewal with their material groups and environment. The intended functions of these components are listed in LRA Table 2.3-4. LRA Tables 3.1-1 and 3.1-2 identify the aging effects requiring management and the plant-specific AMPs required for managing these aging effects during the period of extended operation. The list of components within the scope of license renewal is grouped in accordance with their component types.

In LRA Table 3.1-1, the applicant identifies metal fatigue for ASME Class 1 components as the TLAA that is applicable to the reactor vessel internals. The staff's evaluation of this TLAA is presented in Section 4.3 of this SER.

Aging Effects:

In accordance with LRA Section 3.1, the applicant has performed a review of industry experience and NRC generic communications, relative to the reactor vessel internal components, to provide reasonable assurance that the aging effects that require management

for a specific material-environment combination are the only aging effects of concern for VCSNS. This also included the VCSNS plant-specific operating experience.

As mentioned above, the material of construction for the reactor vessel internal components included in LRA Section 3.1 is Type 304 stainless steel except for (a) the bolts and dowel pins, which are fabricated from Type 316 stainless steel; (b) the radial support key bolts, which are fabricated from Alloy X-750; and (c) the radial support clevis inserts and clevis insert bolts, which are fabricated from Alloy 600. There are no cast austenitic stainless steel (CASS) RV internal components within the scope of license renewal. These components are exposed to chemically treated borated water. The applicant performed a review of industry experience and NRC generic communications, relative to the RV internal components, to provide reasonable assurance that the aging effects that require management for a specific material-environment combination are the only aging effects of concern for VCSNS. This review also included a review of VCSNS plant-specific operating experience.

In LRA Table 3.1-1, the applicant identifies the following aging effects that are applicable to the reactor vessel internal components requiring AMRs:

- loss of fracture toughness in baffle/former bolts and other RV internals due to neutron irradiation embrittlement and void swelling

- changes in dimension of stainless steel and nickel-based alloy components due to void swelling

- crack initiation and growth in baffle/former bolts and other RV internals due to SCC and IASCC

- loss of preload in baffle/former bolts and other RV internals due to stress relaxation

- loss of material in RV internals due to wear

The applicant states that the identification of the above aging effects in LRA Table 3.1-1 is consistent with NUREG-1801 with one clarification. For changes in dimension due to void swelling, the applicant states that the clevis inserts are a nickel-based alloy at the Summer Plant rather than stainless steel as specified in NUREG-1801. The staff finds this clarification acceptable.

As described in topical report WCAP-14577, Rev. 1-A, “License Renewal Evaluation: Aging Management for Reactor Internals,” and the associated staff’s final safety evaluation report (FSER), the aging mechanisms potentially applicable to the RV internals are neutron irradiation embrittlement, stress corrosion cracking (SCC), irradiation-assisted stress corrosion cracking (IASCC), erosion and corrosion processes, creep/irradiation creep, stress relaxation, wear, thermal aging, fatigue, and void swelling. However, the RV internals at VCSNS are made from materials that are resistant to loss of material by general corrosion and flow-assisted corrosion (erosion/corrosion). The RV internals at VCSNS are also not exposed to a high enough temperature (>540 °C or 1000 °F) where creep-induced degradation would become an aging concern for the internals.

Cracking of RV internals due to either SCC or IASCC is an applicable aging effect for RV internals. SCC results from the synergistic effects of tensile stresses and a corrosive environment on a susceptible material. SCC is a particular concern for bolting, given the potential for occluded environmental conditions in crevice areas. IASCC is SCC that is enhanced by exposure of the materials to ionizing radiation. In LRA Table 3.1-1, the applicant has identified cracking as an applicable aging effect for all RV internals. This is acceptable to the staff because the applicant has accounted for cracking of the RV internals that could be induced by either SCC or IASCC.

Loss of material from wear of RV internals occurs due to relative motion between the interfaces and mating surfaces of components caused by flow-induced vibration during plant operation; differential thermal expansion and contraction movements during plant heatup and cooldown; and changes in power operating cycles. The severity of the wear depends on the frequency of motion, duration, and component loadings. The applicant identifies loss of material as an applicable aging effect for all RV internals in Table 3.1-1 of the application. This is acceptable to the staff because the LRA is in agreement with NUREG-1801, in that loss of material is an applicable effect for the RV internals of PWRs and because it specifically accounts for loss of material that could be induced by wear.

Stress relaxation may be defined as the unloading of preloaded components under conditions of long-term exposure of RV internal materials to high constant strain, elevated temperatures, and/or neutron irradiation. Loss of preload due to stress relaxation is an applicable aging effect for those RV internals with substantial preload (e.g., hold down spring, bolted connections). A loss of preload in these components could result in higher cyclic and transient loads, and a loss of function. The combination of bolt stress relaxation, changes in transient and high-cycle vibration of the RV internals, and the effects of increased RV internals fatigue susceptibility may be significant for the license renewal period. The RV internals susceptible to loss of preload due to stress relaxation are the upper and lower support column bolts, the hold down spring, and the clevis insert bolts. In LRA Table 3.1-1, the applicant has identified loss of preload as an applicable aging effect for the upper and lower internals assembly, baffle/former bolts, and hold-down spring.

The rod control cluster assembly (RCCA) guide tube support pins used in Westinghouse RV internals have a history of degradation. Several Westinghouse plants experienced cracking of guide tube support pins manufactured from Alloy X-750. The cracking of the Alloy X-750 material was attributed to the combination of high stress and undesirable microstructure. In WCAP-14577, Rev. 1-A, Westinghouse stated that cracking of the support pins will not result in a significant misalignment and the intended function will be maintained. However, these pins are being replaced at a number of plants. Replacement is considered to be a sound maintenance practice to preclude degradation when industry experience indicates that such degradation has been observed. In Table 3.1-1 of the LRA, the applicant lists the RCCA guide tube support pins as a separate entry. Since the guide tube support pins (split pins) are fabricated from cold-worked Type 316 stainless steel, they have the same aging effects applicable to the other stainless steel components in the guide tube assemblies. This is acceptable to the staff because it agrees with Table 3.1-1 of NUREG-1800 that cracking is an applicable effect for these components.

In LRA Table 3.1-1, AMR Items 5 and 31, the applicant identifies loss of fracture toughness due to irradiation as one of the applicable aging effects for the stainless steel reactor vessel

internals in the fuel zone region. The applicant identifies all of the reactor vessel internals in the fuel zone region as being susceptible to loss of fracture toughness due to irradiation. The staff issued RAI 3.1.2.4.4-1, requesting the applicant to explain why the reactor vessel internals outside the fuel zone region are not considered susceptible to loss of fracture toughness due to irradiation and to submit a criterion used to identify the vessel internals that are susceptible to loss of fracture toughness due to neutron irradiation along with its technical basis.

In response to RAI 3.1.2.4.4-1, in a letter dated June 12, 2003, the applicant states that the details of the reactor vessel internals inspection program have not been developed. The applicant further stated that VCSNS will follow industry initiatives and will have a program in place prior to the period of extended operation. During the June 22, 2003, conference call, the staff requested the applicant to be more specific about how it will identify the vessel internals susceptible to loss of fracture toughness due to neutron embrittlement. In response, the applicant stated that it would consider operating experience gained from aging management activities performed by plants that were originally licensed before VCSNS. The staff finds this response acceptable because the applicant will develop the details of the reactor vessel internals inspection program based on the operating experience of the plants that were originally licensed before VCSNS and have renewed their licenses. These plants would have several years of extended period of operating experience before VCSNS begins its extended period of operation. VCSNS will develop and implement reactor vessel internal inspection program prior to the period of extended operation and will implement aging management activities that are acceptable to the staff.

Void swelling is defined as a gradual increase in dimensions of the RV internals. Under irradiation conditions for the reactor vessel internals, helium is generated as a nuclear transmutation reaction product. At sufficiently high temperatures, helium bubbles expand to a critical diameter and coalesce (unite) into larger bubbles. These bubbles create void areas (gaps) in the materials and may result in the swelling of the material. Swelling changes the dimensions of the material and may affect the ability of the particular RV internal component to perform its intended functions. Although void swelling has not been observed to date, the staff is concerned that void swelling may become significant during the period of extended operation. Until the industry has developed sufficient data to demonstrate that void swelling is not a significant aging mechanism, the staff believes that void swelling should be considered significant, and applicants for license renewal should describe their aging management plan to address void swelling. In LRA Table 3.1-1, the applicant has identified changes in dimension as an applicable aging effect for the RV internals. The applicant's identification of the reactor vessel internals as being susceptible to dimensional changes due to void swelling is acceptable to the staff because it accounts for material degradation that could be induced by this mechanism.

The staff reviewed NUREG-1801 Chapter IV.B2, "Reactor Vessel Internals (PWR) Westinghouse," and confirmed that the applicant¹s identification of the aging effects for the reactor vessel internal components in Table 3.1-1 is consistent with the GALL report and therefore acceptable.

In LRA Table 3.1-2, AMR Item 7, the applicant has also listed loss of material due to crevice and pitting corrosion as a potential aging effect for the RV internals. The stainless steel and nickel-based alloy reactor vessel internal components are inherently resistant to general corrosion; however, loss of material due to crevice and pitting corrosion may be an applicable

effect for these components under wet conditions, especially if the components have creviced areas that may be exposed to the fluids. Therefore, the staff finds that the applicant's identification of loss of material, as an aging effect for stainless steel components exposed to chemically treated borated coolant, is acceptable.

The aging effects identified in the LRA for the RV internal components are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs:

In LRA Tables 3.1-1 and 3.1-2, the applicant identifies the following two AMPs to manage the aging effects associated with the reactor vessel internal components:

- reactor vessel internals inspection program
- chemistry program

The applicant credits the reactor vessel internals inspection program (LRA Appendix B.2.4) alone for managing loss of preload due to stress relaxation in VCSNS hold-down spring, clevis insert bolts, and upper and lower support column bolts (LRA Table 3.1-1, AMR Items 30 and 35). In contrast, NUREG-1801 specifies that both Inservice inspection and loose parts monitoring for managing loss of preload due to stress relaxation in the lower and upper support column bolts (GALL Items IV, B2.1-k and B2.5-h). For the hold-down spring (GALL Item B2.1-d) and clevis insert bolts (GALL Item IV, B2.5-i), NUREG-1801 states that either loose parts monitoring or neutron noise monitoring is to be used in addition to Inservice inspection to manage loss of preload.

The staff issued RAI 3.1.2.4.4-2, requesting the applicant to explain how the reactor vessels internals inspection program, alone, in the absence of either a loose parts monitoring or neutron noise monitoring program will adequately manage this aging effect for these components. In response to RAI 3.1.2.4.4-2, in a letter dated June 12, 2003, the applicant states that VCSNS reactor vessel internals inspection program has not yet been developed but will be developed and implemented prior to the period of extended operation. The applicant further states that VCSNS will follow the practices that are developed from industry initiatives (specifically EPRI and WOG initiatives) and operating experience related to the inspection of reactor vessel internals. Additionally, in response to an action item resulting from the June 22, 2003, conference call, the applicant further states that VCSNS will implement aging management activities that are acceptable to the staff. The applicant has agreed that this is a licensee commitment and this commitment is documented in Appendix A of this SER.

The Chemistry Program (LRA Appendix B.1.4) references water quality that is compatible with the materials of construction used in the reactor vessel internal components in order to minimize loss of material and cracking. This program incorporates EPRI and Institute of Nuclear Power Operations (INPO) guidelines, which reflect industry experience, and the "lessons learned" from VCSNS and external industry operating experience. As discussed in Section 3.1.2.4.2 of this SER, the applicant, in response to RAI 3.1.2.4.2-5, states that the VCSNS chemistry program incorporates the guidelines of EPRI TR-105714, Revision 4. The staff finds the response acceptable because GALL AMP XI.M2, Water Chemistry, refers to

Revision 3 of the same report. Revision 4 of the report is acceptable because it accounts for the industry experience since the publication of Revision 3.

The Chemistry Program is credited with managing the aging effects of several components in different structures and systems and is, therefore, considered a common aging management program. The staff has evaluated this common AMP and found it to be acceptable for managing the aging effects identified for this system. The staff's evaluation of this AMP is presented in Section 3.0.3.2 of this SER.

The staff's evaluation of the reactor vessel internals inspection program is documented in Section 3.1.2.3.5 of this SER.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the RV internal components will effectively manage or monitor the aging effects identified in the LRA.

Conclusions

On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.4.5 In-Core Instrumentation System

The VCSNS in-core instrumentation system is comprised of thermocouples positioned to measure fuel assembly coolant outlet temperatures at preselected positions, and fission chamber detectors, i.e., in-core neutron (flux) detectors, positioned in guide thimbles, which run the length of selected fuel assembly, to measure the neutron fluence distribution.

The in-core flux detectors are directed through the reactor vessel bottom head via thimble tubes, and core exit thermocouples are brought in through the reactor vessel top head. The thimble tubes normally extend from a 10-path transfer device through the seal table, through the bottom of the reactor vessel, and into the selected fuel assemblies. The thimble tubes are retractable, and insertion/retraction of these tubes is directed by long-radius guides below the bottom head and by internals guides between the vessel head and fuel assemblies.

The thimble tubes are sealed at the leading (reactor) end but are open at the 10-path transfer device to allow insertion of an in-core neutron detector. Mechanical high-pressure seals, located at the seal table, are used to seal the area between the thimble tubes and the long-radius guides. This seal serves as a reactor coolant system pressure boundary. The thimble tube wall also serves as a pressure boundary because a leak in a thimble tube results in degradation of the RCS pressure boundary by creating a path for reactor coolant to bypass the mechanical seal.

LRA Section 2.3.1.5 and UFSAR Section 4.4.5.1 describe the VCSNS in-core instrumentation system.

Technical Information in the Application

The applicant describes its AMR of the in-core instrumentation system in LRA Section 3.1, "Aging Management of Reactor Vessel, Internals, and Reactor Coolant System." The staff reviewed this section of the LRA to determine whether the applicant has demonstrated that the effect of aging on the in-core instrumentation system components will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Seven component groups are listed in LRA Tables 3.1-1 and 3.1-2. They include in-core neutron detector thimbles, in-core thermocouples, and tube and tube fittings for in-core neutron detector conduits. The intended functions of these components are to provide in-core guidance and protection and to provide pressure boundary. The tube and tube fittings also provide support to in-core neutron detector conduits.

Aging Effects:

In LRA Tables 3.1-1 and 3.1-2, the applicant identifies the following aging effects for the in-core instrumentation system that are subject to an AMR:

- loss of material
- cracking
- loss of mechanical closure integrity

Aging Management Programs:

In LRA Tables 3.1-1 and 3.1-2, the applicant identifies the following three existing AMPs to manage the aging effects associated with in-core instrumentation system components:

- bottom-mounted instrumentation inspection
- chemistry program
- Inservice inspection plan

The applicant concluded that these AMPs will manage the effects of aging such that the intended functions of the in-core instrumentation system components will be maintained consistent with the CLB under all design loading conditions throughout the period of extended operation, as required by 10 CFR 54.21(a)(3).

Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in LRA Section 3.1, Tables 3.1-1 and 3.1-2, and pertinent sections of LRA Appendices A and B, regarding the applicant's demonstration that the effects of aging will be adequately managed so that the intended function(s) of the in-core instrumentation system components will be maintained consistent with the CLB throughout the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Tables 3.1-1 and 3.1-2, the applicant lists the in-core instrumentation system components within the scope of the license renewal with their material groups and environment. The intended functions of these components are listed in LRA Table 2.3-5. The tables also identify the aging effects requiring management and the plant-specific AMPs required for managing these aging effects during the period of extended operation. The components within

the scope of license renewal are grouped in accordance with their component types, and these groups are listed in these tables.

Aging Effects:

In accordance with LRA Section 3.1, the applicant has performed a review of industry experience and NRC generic communications relative to the in-core instrumentation system components to present reasonable assurance that the aging effects that require management for a specific material-environment combination are the only aging effects of concern for VCSNS. This also included the plant-specific operating experience at VCSNS.

The materials of construction for the in-core instrumentation components include stainless steel and Ni-based alloys. In LRA Table 3.1-1, the applicant identifies the following aging effect applicable to the in-core neutron detector thimble tubes requiring AMR:

- loss of material due to fretting wear of in-core neutron detector thimble tubes caused by flow induced vibrations

The applicant states that the identification of the above aging effect in LRA Table 3.1-1 is consistent with the GALL report.

The staff has reviewed NUREG-1801 Chapter IV.B2, Reactor Vessel Internals (PWR) – Westinghouse, and confirmed that the applicant's identification of the aging effect in LRA Table 3.1-1 for in-core instrumentation system components is consistent with the GALL report, and, therefore, acceptable.

In Table 3.1-2, the applicant identifies the following aging effects for the in-core instrumentation system components:

- loss of material due to crevice and pitting corrosion of all the in-core instrumentation components (except bolted connection for in-core thermocouple seal assemblies), which are made of stainless steel and Ni alloy and exposed to chemically treated borated coolant

- cracking due to stress corrosion cracking of all the in-core instrumentation components (except bolted connection for in-core thermocouple seal assemblies), which are made of stainless steel and Ni alloy and exposed to chemically treated borated coolant

- loss of mechanical closure integrity due to stress relaxation, stress corrosion cracking, and wear of bolted closures for in-core thermocouple seal assemblies

The stainless steel and Ni alloy components are inherently tough and resistant to general corrosion. However, loss of material due to crevice and pitting corrosion may be an applicable effect for these components under wet conditions, especially if the components have creviced areas that may be exposed to the fluids. Therefore, the applicant's identification of loss of material as an aging effect for in-core instrument system stainless steel and Ni alloy components internally exposed to chemically treated borated coolant is acceptable.

The stainless steel and Ni alloy components exposed to PWR reactor coolant (chemically treated borated coolant) are susceptible to cracking due to stress corrosion cracking. Therefore, the applicant's identification of cracking as an aging effect for in-core instrument system stainless steel and Ni alloy components internally exposed to chemically treated borated coolant is acceptable.

In LRA Table 3.1-2, AMR Item 4 identifies stainless steel as material for in-core thermocouple seal bolting. However, in Discussion Column for this AMR item, the applicant refers to high strength material for this bolting. The staff issued RAI 3.1.2.4.5-1a, requesting the applicant needs to clarify this discrepancy. The staff was concerned because if high-strength, low-alloy steel is the bolting material, then the applicant needs to identify loss of material due to boric acid corrosion as an aging effect for this bolting material. In response to RAI 3.1.2.4.5-1a, in a letter dated June 12, 2003, the applicant states that bolting for the in-core thermocouple seal is made of stainless steel. The staff has taken into account this clarification in its evaluation of the AMR results for in-core thermocouple seal bolting.

The applicant identifies loss of closure integrity rather than loss of preload, loss of material and cracking as an applicable aging effect requiring management for closure bolting for in-core thermocouple seals. The staff issued RAI 3.1.2.4.5-1b, requesting the applicant to explain whether loss of closure integrity includes effects of loss of preload, loss of material, and cracking. In response to RAI 3.1.2.4.5-1b, in a letter dated June 12, 2003, the applicant states that the stainless steel bolting is immune to loss of material due to general corrosion or boric acid corrosion and is normally in a dry environment limiting the concerns for pitting and crevice corrosion. However, bolting could experience loss of material due to wear because incore thermocouple seals are disassembled and assembled at each refueling. The applicant further states that cracking is not an applicable aging effect for the bolting material because cracking of bolting in industry is attributed to the use of high yield strength low-alloy steel material and contaminants such as lubricants containing MoS_2. VCSNS has not and does not use lubricants containing MoS_2, and bolting material for in-core thermocouple seals is stainless steel and not high-strength low alloy steel. So the only applicable aging effects for this bolting are loss of material due to wear and loss of preload. The staff finds this response acceptable because it is consistent with the industry experience, i.e., stainless steel bolting exposed to dry containment environment is not susceptible to cracking or loss of material due to corrosion.

In Westinghouse-designed PWRs, mechanical high-pressure seals, located at the seal table, are used to seal the area between the thimble tubes and the long-radius guides. If a bolted connection is employed, then the applicant needs to identify applicable aging effects and present an AMP for managing these effects. The staff issued RAI 3.1.2.4.5-c, requesting the applicant to describe how the sealing of the area between the thimble tube and the guide is obtained. In response to RAI 3.1.2.4.5-c, in a letter dated June 12, 2003, the applicant states that the connection between the in-core instrument thimble tube and the guide tube is made with the standard Westinghouse type tube fitting arrangement. The applicant identifies loss of material due to corrosion and cracking due to SCC as applicable aging effects for the fitting and also for the guide tubes and thimble tubes. The staff finds this identification of aging effects acceptable, as these components are exposed to the chemically treated borated coolant and, therefore, are susceptible to loss of material and cracking.

The aging effects identified in the LRA for the in-core instrumentation system components are consistent with industry operating experience for the materials and environments listed. The

staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs:

In LRA Tables 3.1-1 and 3.1-2, the applicant has identified the following three AMPs for managing the aging effects associated with in-core instrumentation system components:

- bottom-mounted instrumentation inspection program
- chemistry program
- Inservice inspection plan

The bottom-mounted instrumentation inspection program (LRA Section B.1.3) is credited for managing loss of material due to fretting wear of the BMI thimble tubes. The staff has evaluated this AMP in Section 3.1.2.3.6 of this SER.

The Chemistry Program (LRA Section B.1.4) is credited for managing the aging effect of loss of material and cracking on the outside surface of the BMI thimble tubes and the pressure retaining portion of the in-core thermocouples, as well as the inside surface of the guide tubes supporting the thimble tubes between the seal table and vessel lower head. The use of chemistry program alone may not be adequate for managing loss of material and cracking of thimble tubes and guide tubes for the following reason: According to LRA Drawing 1MS-44-014-1, the seal table elevation is the same as the vessel flange elevation. Since the reactor coolant is exposed to containment environment during refueling, the stagnant reactor coolant near the seal table may be oxygenated because of the high elevation. As a result, the stagnant coolant in the guide tubes would be more aggressive than the normal RCS coolant. Therefore, the applicant needs to provide an aging management program to ensure that loss of material and cracking are not taking place at the inside surface of the guide tube and the outside surface of the thimble tube surrounded by the guide tube.

The staff issued RAI B.1.4-1, requesting the applicant to address its concern about potentially accumulated oxygen in the guide tube near the seal table. The response to RAI B.1.4-1, was discussed in the June 22, 2003, conference call between the staff and the applicant. In response to an action item based on this conference call in a letter dated September 2, 2003, the applicant states that buildup of oxygen in the guide tube is not a significant concern. The area between the outside surface of the BMI tubes and the inside surface of the guide tubes supporting the thimble tubes between the seal table and vessel lower head remains filled during refueling and is not opened and drained. If during refueling there is a leakage while the thimbles are withdrawn or inserted, coolant will leak out but air will not leak into the region of concern. The staff does not agree with the applicant that oxygen buildup may not take place in upper portion of the guide tubes. High levelS of oxygen may be introduced into the primary system during shutdown operations as a result of exposing the reactor coolant system to the outside air. This oxygen may accumulate in the upper portion of the guide tubes because the elevation of the seal table, which is same as the vessel flange elevation. The applicant, accumulated oxygen is not of concern because except very near the vessel the temperature of the thimble tube and guide tube is at ambient air temperature. At the seal table the temperature is less than 49°C (120°F), which significantly reduces the potential of loss of material and cracking of the fitting. Therefore, the staff accepts the applicant’s position that the chemistry program is adequate for managing loss of material and cracking of the thimble tube

and guide tube between the vessel lower head and seal table except very near the vessel where temperature are higher than 93°C (200°F).

In a conference call on September 16, 2003, the staff informed the applicant that their September 2, 2003 response did not provide aging management for cracking due to SCC of the stainless steel guide tube in close proximity to the reactor vessel. In a response, by letter dated September 24, 2003, the applicant states that the stainless steel in-core neutron detector conduits (guide tubes) are welded to the nickel-based alloy bottom head penetration tubes. The staff reviews aging management of bottom head penetrations, as proposed by the applicant, in Section 3.1.2.2.9 of this SER and finds it adequate. The applicant credits the Alloy 600 aging management program (LRA Appendix B.1.1) in addition to the chemistry program (LRA Appendix B.1.4) for managing cracking in the bottom head penetration tubes. The Alloy 600 aging management program provides for inspecting the signs of boric acid leakage from the bottom head penetration, including its weld with the guide tube, during outages and monitoring primary coolant leakage per Technical Specifications during plant operation.

The applicant further states that the bottom head penetrations extend over eight inches from the bottom surface of the vessel where they are welded to in-core neutron detector conduits. The configuration of the conduits tends to allow a significant temperature reduction from the RCS temperature. In addition, chemistry controls of the reactor coolant significantly reduce the source of contaminates and measures were taken to prevent sensitization during fabrication. The applicant concludes that the combination of these factors reduces the likelihood of stress corrosion cracking of the conduit and, therefore, the chemistry program alone is adequate for managing cracking due to SCC of the conduit and a one-time inspection is not required. The staff finds the use of the chemistry program alone for managing cracking due to SCC in the in-core neutron detector conduit that is in close proximity of the vessel bottom head acceptable because the weld between the conduit and the bottom head penetration will be inspected as part of the aging management of the bottom head penetrations. In addition, this weld is the bounding location for the guide tube as far as cracking due to SCC is concerned because the temperature at the weld will be higher than at any other locations on the conduit. This closes the RAI B.1.4-1.

The applicant credits the ISI plan (LRA Section B.1.7) for managing loss of closure integrity of the closure bolting. The staff issued RAI 3.1.2.4.5-1b, requesting the applicant to explain how ISI plan would manage loss of closure integrity, i.e., loss of material due to wear and loss of preload, and ensure that the pressure boundary of the bolted joint would be maintained during the extended period of operation. In response to RAI 3.1.2.4.5-1b, in a letter dated June 12, 2003, the applicant states that this bolting is disassembled and assembled at each refueling. The ISI plan requires surface examination of all bolting when it is disassembled, i.e., at each refueling. The surface examination will detect any loss of material due to wear. Retorquing to the desired preload during each refueling will remove the loss of preload that might have taken place during the preceding fuel cycle. The staff accepts the applicant response because the applicant is adequately managing the applicable aging effects for the closure bolting for in-core thermocouple seals by managing loss of closure integrity of this bolting.

The staff has evaluated this common AMP and, found it acceptable for managing the aging effects for the in-core instrumentation system components. The staff's evaluation of this AMP is presented in Section 3.0.3 of this SER.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the in-core instrumentation system components will effectively manage or monitor the aging effects identified in the LRA.

Conclusions

On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.4.6 Pressurizer

The VCSNS pressurizer is a vertical, cylindrical vessel with a hemispherical top and bottom heads constructed of low alloy steel (SA533 Grade A Class 2), with austenitic stainless steel cladding on all surfaces exposed to the reactor coolant. A stainless steel liner, i.e., thermal sleeve, is used in lieu of cladding in some nozzles. The surge line nozzle and removable electric heaters are installed in the bottom head. A thermal sleeve is provided to minimize stresses in the surge line nozzle. Spray line nozzles, relief, and safety valve connections are located in the top head of the pressurizer. The skirt type support is attached to the lower head and extends for a full 360 degrees around the vessel. The lower part of the skirt terminates in a bolting flange with bolt holes securing to its foundation. The VCSNS pressurizer is designed and constructed in accordance with the ASME Code, Section III.

The VCSNS pressurizer instrumentation includes 2 temperature detectors, one in the steam phase and 1 in the water phase, 3 pressure transmitters, and 3 liquid level transmitters.

During an outsurge from the pressurizer, flashing of water to steam, and the generation of steam by automatic actuation of the heaters keep the pressure above the minimum allowable limit. During an insurge from the RCS, the spray system, which is fed from two cold legs, condenses steam in the vessel to prevent the pressurizer pressure from reaching the set point of the power operated relief valves for normal operating transients. Heaters are energized on high water level during insurge to heat the subcooled surge water that enters the pressurizer from the reactor coolant loop.

UFSAR Sections 5.5.10 and 5.6 describe the VCSNS pressurizer design and LRA Section 2.3.1.6 identifies the pressurizer components that are within the scope of license renewal and their intended functions.

Technical Information in the Application

The applicant describes its AMR of the pressurizer components in LRA Section 3.1, “Aging Management of Pressurizer.” The staff reviewed this section of the LRA to determine whether the applicant has demonstrated that the effects of aging on the pressurizer will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Ten component groups associated with the pressurizer are listed in LRA Tables 3.1-1 and 3.1-2. They include shell components, nozzles, head penetrations, and CRDM housings. The

intended function of all of these components is to provide a pressure boundary. The reactor vessel core support pads support the reactor vessel internals.

Aging Effects:

In LRA Tables 3.1-1 and 3.1-2, the applicant identifies the following aging effects for the pressurizer components that are subject to an AMR:

- cracking
- loss of material
- loss of closure integrity

Aging Management Programs:

In LRA Tables 3.1-1 and 3.1-2, the applicant identifies the following existing AMPs to manage the aging effects associated with the pressurizer:

- alloy 600 aging management program
- chemistry program
- Inservice inspection plan
- boric acid corrosion surveillance program

The applicant concluded that these AMPs will manage the effects of aging such that the intended functions of the pressurizer components will be maintained consistent with the CLB under all design loading conditions throughout the period of extended operation, as required by 10 CFR 54.21(a)(3). The applicant identifies metal fatigue (Section 4.3 of the LRA) as a TLAA in Section 3.1 of the LRA that is applicable to pressurizer components.

<u>Staff Evaluation</u>

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in LRA Section 3.1, Tables 3.1-1 and 3.1-2, and pertinent sections of LRA Appendices A and B, regarding the applicant's demonstration that the effects of aging will be adequately managed so that the intended function(s) of the pressurizer will be maintained consistent with the CLB throughout the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Tables 3.1-1 and 3.1-2, the applicant lists the pressurizer components within the scope of the license renewal with their material groups and environment. The intended functions of these components are listed in LRA Table 2.3-6. The tables also identify the aging effects requiring management and the plant-specific AMPs required managing these aging effects during the period of extended operation. The components within the scope of license renewal are grouped in accordance with their component types, and these groups are listed in these tables. In LRA Section 4.3, the applicant identifies metal fatigue as a TLAA that is applicable to pressurizer components. The staff's evaluation of this TLAA is presented in Section 4.3 of this SER.

Aging Effects:

In accordance with LRA Section 3.1, the applicant has performed a review of industry experience and NRC generic communications, relative to the pressurizer components, to provide reasonable assurance that the aging effects that require management for a specific material-environment combination are the only aging effects of concern for VCSNS. This also included the VCSNS plant-specific operating experience.

The material of construction for the pressurizer components subject to an AMR are low-alloy steels (SA533 Grade A, Cl 2 and SA508 Cl 2A) for the pressure retaining components including shell and heads; austenitic stainless steels for nozzle safe ends, thermal sleeves, and heater wells; stainless steel weld metal for cladding and buttering; SA193 Gr B-7 for closure bolting; and Alloy 82/182 weld metal for bimetallic welds and partial attachment welds. In LRA Table 3.1-1, the applicant identifies the following aging effects applicable to the pressurizer components requiring an AMR:

- cracking of Alloy 82/182 welds between pressurizer nozzles and safe ends, between thermal sleeves and safe ends, and between heater sleeves and the pressurizer lower head, exposed to chemically treated borated coolant

- cracking of stainless steel instrument and sample lines, heater sleeves, thermal sleeves, and safe ends exposed to chemically treated borated coolant

- cracking of pressurizer shells, heads, and nozzle cladding with stainless steel and internally exposed to chemically treated borated coolant

- cracking of pressurizer integral supports

loss of material in low-alloy steel pressurizer shells and heads, and closure bolting externally exposed to leaking borated coolant

The applicant states that the identification of the above aging effects in LRA Table 3.1-1 is consistent with the GALL report. However, the GALL report presents an AMR for six additional pressurizer components (pressurizer seismic lugs, heater elements (heater sheaths), manway pad gasket seating surface, safety valves, relief valves, and spray nozzles) that are not addressed in the LRA. The staff issued RAI 3.1.2.4.6-1, requesting that the applicant submit an explanation for not presenting an AMR for the following pressurizer components: seismic lugs, heater elements, manway pad gasket seating surface, safety valves, and relief valves. In response to RAI 3.1.2.4.6-1, in a letter dated June 12, 2003, the applicant submitted the following explanation for the first three components. The pressurizer seismic lugs are included with the pressurizer shell and are not included as a separate component. Immersion heater well assemblies is the component name used at VCSNS for the heater sheaths and they are included in LRA Table 3.1-1, Item 24, and LRA Table 3.1-2 Items 1 and 7. The manway pad gasket-seating surface is the stainless steel clad mating surface of the manway nozzle and is not called out as a separate component. The staff finds the explanation acceptable because the AMR results for the three components are included in the LRA. In response to RAI 3.1.2.4.6-1, the applicant further states that the AMR results for the pressurizer safety and relief valves are included in LRA Table 3.1-1, Items 19 and 24, and LRA Table 3.1-2, Items 1 and 5.

The staff finds the response acceptable because the applicant includes these valves within the scope of license renewal. The staff's evaluation of the AMR results for these valves is presented in Section 3.1.2.4.2 of this SER. As discussed in Section 2.3.1.6.2 of this SER, pressurizer spray head is not within the scope of license renewal.

According to LRA Table 2.3-6, the applicant presents the AMR results for the pressurizer nozzles and safe ends. However, it is not clear to the staff about which specific nozzles are addressed by the LRA. The staff issued RAI 3.1.2.4.6-2, requesting the applicant to confirm whether the following five pressurizer nozzles and safe ends are included within the scope of the LRA: surge nozzles, spray nozzles, safety nozzles, relief nozzles, and their safe ends, and instrument nozzles. In response to RAI 3.1.2.4.6-2, in a letter dated June 12, 2003, the applicant states that the five nozzles and safe ends are within the scope of the LRA. The staff finds the response acceptable because the same nozzles and safe ends are identified as the components within the scope of license renewal by the Westinghouse report WCAP 14574-A.

In LRA Table 2.3-6, the applicant presents the AMR results of the pressurizer manway cover (Row 4), manway cover (Row 6) and manway forgings (Row 7) exposed to chemically treated borated coolant. The staff issued RAI 3.1.2.4.6-3, requesting that the applicant explain the difference between the manway cover and the manway forgings. In response to RAI 3.1.2.4.6-3, in a letter dated June 12, 2003, the applicant explains that the manway cover listed in Row 4 of LRA Table 2.3-6 is a non-structural stainless steel insert. The staff finds the response related to the manway cover (Row 4) acceptable because it is consistent with the corresponding AMR results presented in the LRA. However, the staff determined that the remaining part of the applicant's explanation was not clear. Therefore, the staff further discussed this RAI with the applicant during the June 22, 2003, conference call which is discussed below.

Based on the conference call, the applicant submitted the following additional information in response to RAI 3.1.2.4.6-3. The major components of the pressurizer manway include the manway forgings, manway covers, and manway cover inserts. The manway covers and forgings are made of low-alloy steel, whereas the manway cover insert is made of stainless steel, as mentioned earlier. The manway forging is welded to the pressurizer shell. The applicant further indicated that the manway cover is a pressure-retaining component that is bolted to the manway forging. The stainless steel insert prevents the manway cover from being in direct contact with the reactor coolant. The aging effect that the applicant identified for the manway covers and forgings is loss of material due to boric acid corrosion. An additional aging effect for the manway forgings is cumulative fatigue damage. The aging effects for the manway cover inserts are loss of material due to pitting and crevice corrosion and cracking due to stress corrosion cracking. The staff finds the information provided by the applicant in its response to the staff acceptable because the identification of aging effects is consistent with GALL.

The staff reviewed NUREG-1801 Chapter IV.C2, Reactor Coolant System and Connected Lines, and confirmed that the applicant's identification of the aging effects in Table 3.1-1 for the pressurizer components is consistent with the GALL report, and, therefore, acceptable.

In Table 3.1-2, AMR Items 7 and 11, the applicant identifies the following two aging effects for the pressurizer components:

- loss of material due to pitting and crevice corrosion of the pressurizer shells, heads, manway cover inserts, and nozzles with stainless steel cladding, and safe ends, safe end weld metals, thermal sleeves, heater wells, instrument lines and sample lines

- cracking due to SCC of the manway cover insert, heater wells, and instrument and sample lines and their couplings

The stainless steel and Ni alloy components are inherently tough and resistant to general corrosion. However, loss of material due to crevice and pitting corrosion may be an applicable aging effect for these components under wet conditions, especially if the components have creviced areas that may be exposed to the fluids. Therefore, the applicant's identification of loss of material as an aging effect for the in-core instrumentation system stainless steel and Ni alloy components internally exposed to chemically treated borated coolant is acceptable.

Identification of cracking due to SCC as an applicable aging effect for the manway cover insert, heater wells, and instrument and sample lines and their couplings, is consistent with GALL (see GALL Items IV.C2.2-f, IV.C2.5-m, IV.C2.5-r). Therefore, this identification is acceptable.

According to Section 3.2.5 of the Westinghouse report, WCAP-14574-A, four components of the pressurizer for which an AMR is performed, are exposed to fluid flows that have the potential to result in erosion of the components: surge nozzle thermal sleeves and safe ends, and spray nozzle thermal sleeves and safe ends. The staff, however, considered the discussion in the WCAP report regarding the loss of material due to erosion unclear. Therefore, the staff issued RAI 3.1.2.4.6-4, requesting the applicant to explain why loss of material due to erosion is not an applicable aging effect for these identified pressurizer components at VCSNS.

In response to RAI 3.1.2.4.6-4, in a letter dated June 12, 2003, the applicant submitted the following explanation. The applicant states that these components are made of stainless steel, an erosion resistant material, and are not normally exposed to high velocity flow or two-phase flow. In addition, the pressurizer pressure control is operated in a manner to reduce the spray flow to a minimal amount. As a result, spray flow is normally several gallons a minute verses the 750 gallons a minute design flow. Therefore, the applicant states that this low flow rate into the pressurizer through the 4-inch spray nozzle and 14-inch surge nozzle safe ends and associated thermal sleeves is insignificant to require erosion evaluations. The staff agrees with the applicant’s explanation that loss of material due to erosion is not an applicable aging effect for the pressurizer safe ends and nozzles because the actual flow velocities are much lower than the design flow velocities and would not cause erosion.

The attachment welds at the inside surface of the pressurizer may be susceptible to crack initiation and growth due to stress corrosion cracking and fatigue. The applicant does not identify cracking as an applicable aging effect for the attachment welds. The staff issued RAI 3.1.2.4.6-5, requesting the applicant to identify the components that are welded to the inside surface of the pressurizer and to submit its technical justification for whether cracking due to SCC is an applicable aging effect. In response to RAI 3.1.2.4.6-5, in a letter dated June 12, 2003, the applicant stated that the support brackets for the heater supports are the only components welded to the pressurizer clad. The applicant further stated that these materials are not sensitized and referred to Section 5.2.5.2, Prevention of Intergranular Attack of

Unstabilized Austenitic Stainless Steels, of the VCSNS UFSAR, for further information supporting its statement.

UFSAR Section 5.2.5.2 states that the Westinghouse design provides control of welding processes and procedures to avoid heat-affected zone sensitization and control of the primary water chemistry to ensure a benign environment. These controls prevent stress corrosion cracking of wrought stainless steel weldments. However, the UFSAR does not provide a discussion of the VCSNS plant-specific procedures and quality assurance requirements for the welding and testing of the attachment welds and their associated heat-affected zones. The applicant does not state whether the control of welding processes and procedures provided by the Westinghouse design are consistent with the regulatory position presented in Regulatory Guide 1.44, Control of the Use of Sensitized Stainless Steel. Although the applicant does not identify cracking as an aging effect for the attachment welds, the VCSNS aging management activities evaluated in the next section (Section 3.1.2.4.6) also manages cracking of the attachment welds. Therefore, not identifying cracking as an applicable aging effect for the pressurizer attachment welds, does not have significant safety consequences. The staff finds this acceptable because cracking of the attachment welds will be managed, even though the applicant has not identified it as an applicable aging effect.

The aging effects identified in the LRA for the pressurizer components are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs:

In LRA Tables 3.1-1 and 3.1-2, the applicant has identified the following four AMPs for managing the aging effects associated with pressurizer:

- boric acid corrosion surveillance program
- alloy 600 aging management program
- chemistry program
- Inservice inspection plan

The boric acid corrosion surveillance program (LRA Section B.1.2) was developed by the applicant in response to NRC Generic Letter 88-05. Inspections are performed to present reasonable assurance that borated water leakage from the reactor coolant pressure boundary does not lead to undetected loss of material on the external surfaces of carbon steel or low alloy steel components. The staff has evaluated this common AMP and found it to be acceptable for managing the aging effect of loss of material identified for the RCS pressure boundary components made of carbon steel or low-alloy steel. The staff’s evaluation of the boric acid corrosion surveillance program is documented in Section 3.0.3 of this SER. The evaluation of the alloy 600 program, as it is applied for managing PWSCC cracking of the Alloy 82/182 welds, is presented in Section 3.1.2.3.1 of this SER.

In LRA Table 3.1-2, AMR Item 7, the applicant credits the chemistry program (LRA Appendix B.1.4) for managing loss of material due to crevice and pitting corrosion in pressurizer shell and head cladding with austenitic stainless steel and stainless steel components internally exposed to chemically treated borated coolant, i.e., PWR primary water. These components are

susceptible to crevice and pitting corrosion because high levels of oxygen may be present in the PWR reactor coolant. However, PWR licensees maintain hydrogen overpressure in the reactor coolant, and if the overpressure reaches a sufficiently high level, it would provide protection in creviced geometries on the internal surfaces of the pressurizer.

In RAI B.1.4-5, the staff requested the applicant to discuss how the chemistry program will provide for a sufficient level of hydrogen overpressure to manage crevice corrosion of the internal surfaces of the pressurizer. In response to RAI B.1.4-5, the applicant states that the chemistry program alone is adequate for managing loss of material due to crevice and pitting corrosion in the pressurizer stainless steel components including cladding because hydrogen in the borated coolant is controlled as recommended by the EPRI PWR water chemistry guidelines. These guidelines are presented in an EPRI report, "PWR Primary Water Chemistry Guidelines-Revision 4," EPRI TR-105714. According to these guidelines, hydrogen is controlled between 25-50 cc/kg H_2O in the RCS to ensure scavenging of oxygen and, thus, protection against crevice and pitting corrosion. In EPRI TR-105714, it is stated that the computations of production rates of oxidizing species by radiolysis suggest a dissolved hydrogen concentration of significantly less than 15 cc/kg is sufficient to scavenge the oxidizing species under all operating conditions. Since oxygen can also be added to the coolant from other sources, an excess inventory of hydrogen must be maintained while the reactor is at power. Therefore, the guidelines set a range of 25-50 cc/kg to provide a margin against the oxidizing conditions and to facilitate operational control. The staff finds it acceptable that the chemistry program alone is adequate for managing crevice and pitting corrosion in the VCSNS pressurizer stainless steel components including cladding because the applicant follows the EPRI primary water chemistry guidelines that ensure scavenging of oxygen from the PWR primary water.

LRA Table 3.1-1, AMR Item 24, credits the chemistry program (LRA Appendix B.1.4) and the in-service inspection plan (LRA Appendix B.1.7) for managing cracking of the pressurizer shell, and lower head and upper head cladding with austenitic stainless steel and internally exposed to chemically treated borated coolant. The in-service inspection plan is mainly directed at structural welds in the pressurizer shell and heads and not at the stainless steel cladding. However, in 1990, crack like indications were discovered in the Haddam Neck pressurizer cladding. Thermal fatigue can initiate and propagate such cracking through the cladding and into the ferritic base metal or weld metal beneath the clad. In RAI 3.1.2.4.6-6, the staff requested the applicant to submit an AMP to verify whether thermal fatigue-induced cracking has initiated in the clad and propagated through it into the ferritic base metal or weld metal beneath the clad. In response to RAI 3.1.2.4.6-6, in a letter dated June 12, 2003, the applicant states that the pressurizer shell design considers fatigue usage and the pressurizer surge line nozzle as the limiting location from a fatigue usage perspective. The applicant further states that the inspection of the surge line nozzle weld is included in the ISI plan (LRA Appendix B.1.7). Therefore, inspection of the surge line nozzle weld indirectly provides condition monitoring of the pressurizer cladding; therefore, a specific aging management program to address cracking of the pressurizer cladding due to fatigue is not required. The staff accepts the applicant's response because the surge line weld is most susceptible to fatigue cracking and its inspection would bound the other locations on the pressurizer cladding.

The staff has evaluated the chemistry program (LRA Appendix B.1.4) and found it acceptable for managing cracking of pressurizer shells, lower head and upper head cladding with austenitic

stainless steel internally exposed to chemically treated borated coolant. The staff's evaluation of this AMP is presented in Section 3.0.3 of this SER.

LRA Table 3.1-1, AMR Item 26, credits the boric acid corrosion surveillance program (LRA Appendix B.1.2) for managing loss of material due to boric acid corrosion of the following pressurizer carbon steel and low alloy steel components: shells, upper and lower heads, nozzles, integral supports, and manway covers and bolts. The staff identified that the applicant does not present sufficient detail about how the program will be sufficient to manage the corrosive effects of boric acid leakage on these components during the extended period of operation, including postulated leakage from the pressurizer nozzle-to-vessel welds, pressurizer nozzle-to-safe end welds, and pressurizer manway bolting materials.

In RAI B.1.2-3, the staff requested the applicant to discuss how this program will be sufficient to manage the corrosive effects of boric acid leakage on the base metal of these insulated components during the extended period of operation. In response to RAI B.1.2-3, in a letter dated June 12, 2003, the applicant states that the insulation on the mechanical joints on the pressurizer is removed and the joints are inspected for leakage at each refueling. Corrective actions for boric acid leaks are required for the source as well as the adjacent supports, or structures and detected boric acid deposits are removed. For additional information, the applicant refers to a letter from S. A. Byrne to the Document Control Desk, dated January 24, 2003, "Response for Additional Information Regarding 60-Day Response to NRC Bulletin 2002-01 Reactor Pressure Vessel Head Degradation and Reactor Coolant Pressure Boundary Integrity." The letter states that the pressurizer manways and dissimilar welds on the pressurizer nozzles and their adjacent areas are examined for boric acid residue. The dissimilar welds include pressurizer nozzle welds to pressurizer safety valves, PORVs, spray piping, and surge lines. The staff finds the response acceptable because the boric acid corrosion surveillance program includes examination of Alloy 82/182 welds (dissimilar welds) on the pressurizer nozzles and of the adjacent areas. The staff noted that not all of the inspections include removal of insulation. The staff is pursuing further action with respect to removal of the insulation during these inspections on a generic basis. The staff has evaluated the boric acid corrosion surveillances program (LRA Appendix B.1.2) and found it acceptable for managing loss of material due to boric acid corrosion of the external surfaces of the pressurizer carbon steel and low alloy steel components. The staff's evaluation of this AMP is presented in Section 3.0.3.1 of this SER.

LRA Table 3.1-1, AMR Item 22, credits the in-service inspection plan (LRA Appendix B.1.7) for managing loss of mechanical closure integrity, which includes loss of preload, loss of material and cracking, of the bolted closures for the pressurizer manway cover bolts. The Inservice inspection plan, which is based on ASME Section XI, Subsection IWB, requires volumetric, and VT-1 and VT-2 visual examinations of bolts. As discussed in Section 3.1.2.4.7 of this SER, the staff finds that management of closure integrity by the ISI plan is adequate for managing loss of material, cracking, and loss of preload in bolted closures. The staff has evaluated the in-service inspection plan and found it acceptable for managing the aging effects for the pressure boundary components bolting. The staff's evaluation of this AMP is presented in Section 3.1.2.3.3 of this SER.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the pressurizer components will effectively manage or monitor the aging effects identified in the LRA.

Conclusions

On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.4.7 Steam Generators

The VCSNS replacement Westinghouse Delta-75 steam generators are described in detail in the UFSAR Section 5.5.2. To facilitate replacement in the plant, the geometric characteristics of these replacement steam generators are identical to the original Westinghouse D-3 steam generators. The replacement steam generators were designed and analyzed in accordance with Section III of the ASME Code, 1971 Edition (through summer 1971 Addenda) and were constructed in accordance with the 1986 edition.

The Delta-75 steam generator utilizes a vertical shell and U-tube evaporator with integral moisture separation equipment. The reactor coolant flows through the inverted U-tubes, entering and leaving through the nozzles located in the hemispherical bottom head (channel head) of the steam generator. The channel head is divided into inlet and outlet chambers by a vertical partition plate extending from the head to the tubesheet. Manways are provided for access to both sides of the divided channel head. The feedwater inlet is located at approximately 2/3 of the steam generator height and feedwater is distributed equally around the circumference of the steam generator shell. Feedwater enters the tube bundle by flowing downward between the steam generator external shell and inner wrapper barrel. An open area at the bottom of the wrapper barrel permits the feedwater to enter the tube bundle. Steam is generated and flows upward through the moisture separators and through the flow restrictor outlet nozzle at the top of the steam drum. The steam generator utilizes high efficiency centrifugal steam separators, which remove most of the entrained water. Chevron dryers are employed to increase the steam quality to a minimum of 99.90% (0.10% moisture).

The steam generator channel head and tubesheet are protected from the primary water by applying an autogenous weld deposited stainless steel cladding to the primary surfaces of the channel head and Inconel to the tubesheet The cladding surface is machined to a smooth condition and electropolished, thereby reducing the collection of radioactive contamination inside the steam generators during refueling and maintenance periods. The 17.46-mm (11/16-in.) diameter steam generator tubes are fabricated of thermally treated Alloy 690 and are full-depth hydraulically expanded into the tubesheet. The tube support plates are fabricated of Type 405 stainless steel with broached trefoil holes. The U-bends in the first nine rows of tubes are heat treated to relieve residual stresses from bending.

Summary of Technical Information in the Application

The passive, long-lived steam generator components that are subject to an AMR are identified in LRA Table 2.3-7. The components, aging effects, and aging management programs are discussed in LRA Section 3.1 and they are listed in LRA Tables 3.1-1 and 3.1-2. The staff reviewed Section 3.1 of the LRA to determine whether the applicant has demonstrated that the effects of aging on the steam generator components will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Aging Effects:

In LRA Tables 3.1-1 and 3.1-2, the applicant identifies the following applicable aging effects for the steam generator components subject to an AMR: cumulative fatigue damage, loss of material, and crack initiation and growth. In Table 2.3-7 and Table 3.1-2, item 2, the applicant identifies no applicable aging effects for the stainless steel primary-side nozzle safe ends with nickel-based welds.

Aging Management Programs:

In LRA Tables 3.1-1 and 3.1-2, the applicant identifies the following five AMPs to manage the aging effects associated with the steam generator components:

- Steam Generator Management Program (LRA Appendix B.1.10)
- Chemistry program (LRA Appendix B.1.4)
- Boric acid corrosion surveillances (LRA Appendix B.1.2)
- In-service inspection plan (LRA Appendix B.1.7)
- Alloy 600 aging management program (LRA Appendix B.1.1)

The steam generator management program is an existing program developed by the applicant specifically to manage cracking and loss of material in steam generator tubes and plugs. The Alloy 600 management program is an existing program developed by the applicant to manage primary water stress corrosion cracking of nickel-based alloy sub-components of the steam generators that are exposed to borated water to ensure that the pressure boundary function is maintained during the period of extended operation. The Alloy 600 Aging Management Program includes elements of the boric acid corrosion surveillances and the ASME Section XI System Pressure Test Program and the ASME Section XI Inservice Examination Program. The applicant's Inservice inspection (ISI) plan, chemistry program, and boric acid corrosion surveillances are common AMPs that are credited by the applicant with managing aging effects in several system component groups, and are evaluated in Section 3.0.3 of this SER.

The applicant concluded that these five AMPs will manage the effects of aging such that the intended function of the steam generator components will be maintained consistent with the CLB under all design loading conditions throughout the period of extended operation, as required by 10 CFR 54.21(a)(3).

Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in LRA Section 3.1, including Tables 3.1-1 and 3.1-2, and LRA Appendices A and B to determine that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) of the steam generator components will be maintained consistent with the CLB throughout the period of extended operation.

In LRA Tables 3.1-1 and 3.1-2, the applicant identifies the steam generator components within the scope of the license renewal, their material groups, environments, associated aging effects, and corresponding aging management programs. The intended functions of these components are listed in LRA Table 2.3-7.

In LRA Section 4.3, the applicant identifies metal fatigue as the only TLAA applicable to the steam generator pressure boundary components. The staff's evaluation of this TLAA is in Section 4.3 of this SER.

Aging Effects:

The applicant has performed a review of industry experience, NRC generic communications, and the VCSNS plant-specific operating experience related to the steam generator components to provide reasonable assurance that the aging effects that require management for a specific material-environment combination are the only aging effects of concern for VCSNS steam generators.

The materials of construction for the steam generator components are specified in Table 5.2-8 of the UFSAR. The shell, pressure forgings (including the nozzles and tubesheet), and channel head are fabricated of SA508, Class 3a, low-alloy steel. The channel head, which is in contact with borated primary water, is clad with weld-deposited Type 309L/308L austenitic stainless steel, and the tubesheet primary surfaces are weld clad with the Ni-Cr-Fe alloy N06082/W86182. The nozzle safe ends are fabricated of forged stainless steel. The steam generator tubes are fabricated of thermally treated Alloy 690 (SB163 procured to ASME Code Case N-20-3), and the tube support plates are made of Type 405 ferritic stainless steel. The steam generator closure studs are made of SA193, Grade B-7, low-alloy steel and the closure nuts are made of SA194, Grade 7, low-alloy steel.

Review of Aging Effects on Steam Generator-Related Items in LRA Table 3.1-1

In LRA Table 3.1-1, the applicant identifies the following aging effects applicable to the steam generator components requiring AMPs that are specified in the GALL report and are relied upon for VCSNS license renewal:

- loss of material in the steam generator shell assembly due to pitting and crevice corrosion

- crack initiation and growth in the steam generator tubes, repair sleeves, and plugs due to primary water stress corrosion cracking (PWSCC), outer diameter stress corrosion cracking (ODSCC), and/or intergranular attack (IGA)

- loss of material in the steam generator tubes, repair sleeves, and plugs due to wastage and pitting corrosion and fretting and wear

- deformation of the steam generator tubes due to corrosion at the tube support plate intersections

- loss of closure integrity for closure bolting

- loss of material in the external surfaces of carbon steel and low-alloy steel components in the reactor coolant system pressure boundary due to boric acid corrosion

- crack initiation and growth in the steam generator upper and lower heads, tubesheets, and primary nozzles and safe ends due to SCC

- crack initiation and growth in the steam generator nozzle Alloy 82/182 welds exposed to the chemically treated borated coolant due to PWSCC

The staff's evaluation of the applicability of each of the above aging effects to the relevant components is as follows:

In LRA Table 3.1-1, Item 2, the applicant addresses loss of material due to pitting and crevice corrosion in the steam generator shell assembly. However, the applicant identifies cracking and not the loss of material due to pitting and crevice corrosion as the aging effect to be managed. The applicant further states that NRC IN 90-04 contains only general indication that pits on the surface served as crack initiation sites, and not that pitting corrosion resulted in sufficient degradation to cause loss of component function. The staff finds that the applicant provides insufficient basis to support its assertion that loss of material due to pitting and crevice corrosion is not an applicable aging effect for the steam generator shell assembly. The staff's evaluation of these AMR results is presented in Section 3.1.2.2.2 of this SER.

In LRA Table 3.1-1, AMR Item 9, the applicant addresses possible crack initiation and growth due to SCC and PWSCC in various stainless steel and nickel-alloy components. In the discussion section for this AMR item, the applicant does not include steam generator instrument lines in the component group for aging management. The staff issued RAI 3.1.2.4.7-1, requesting the applicant to confirm whether instrument and drain lines in VCSNS steam generators are made of Alloy 600 and addressed by this AMR item. The staff also requested the applicant to provide information about whether Alloy 82/182 weld metal used in the nozzle welds that are addressed by this AMR item. In its response to RAI 3.1.2.4.7-1, in a letter dated June 12, 2003, the applicant states that at VCSNS only the core support pads and bottom head penetrations are included in LRA Table 3.1-1, AMR Item 9. The steam generator instrument and drain lines are not made of Alloy 600 material. In addition, the applicant states that the primary side of the VCSNS steam generators does not have Alloy 600 or Alloy 82/182 weld material exposed to borated water other than the cladding of the primary side of the tube sheet. The staff concludes that it is acceptable that the aging effect of crack initiation and growth due to SCC and PWSCC are not applicable to the nozzles for the steam generator instruments and drains because they are not made of Alloy 600 and do not have Alloy 82/182 weld materials.

In LRA Table 3.1-1, AMR Item 15, the applicant addresses the potential aging effects of cracking, loss of material, and deformation in steam generator tubes and plugs. The staff's evaluation of these aging effects and their management is presented in Section 3.1.2.2.15 of this SER. The staff concluded that the applicant has adequately evaluated the management of (1) crack initiation and growth due to PWSCC, ODSCC, or IGA, or (2) loss of material due to wastage and pitting corrosion, (3) loss of material due to fretting and wear, or (4) deformation (denting) due to corrosion of carbon steel tube support plate in the Steam generator tubes and plugs, as recommended in the GALL Report.

In LRA Table 3.1-1, AMR Item 17, the applicant addresses ligament cracking of carbon steel support plate due to corrosion. The applicant states that this aging effect is not an applicable aging effect because the support plates at VCSNS steam generators are made of Type 405 stainless steel and not carbon steel. The staff finds this explanation acceptable because based on industry experience, Type 405 stainless steel exposed to secondary side treated water is not

likely to be susceptible to corrosion and, therefore, will not likely to experience ligament cracking.

In LRA Table 3.1-1, AMR Item 21, the applicant addresses potential loss of material (wall thinning) due to flow-assisted corrosion (FAC) for the steam generator steam and feedwater nozzles and safe ends. The applicant states that this effect is not an applicable aging effect for these components at VCSNS and aging management is therefore not required, but provides no justification for this conclusion. The staff issued RAI 3.1.2.4.7-4, requesting the applicant to provide the technical basis for determining that loss of material caused by FAC is not an applicable aging effect for the steam generator nozzles and safe ends. In its response to RAI 3.1.2.4.7-4, in a letter dated June 12, 2003, the applicant states that the main steam exiting the steam generators is dry (less than 0.1% moisture), and dry steam is not a concern for flow-accelerated corrosion. In addition, according to the Westinghouse report, "Westinghouse Delta 75 Steam Generator Design and Fabrication information for the Virgil C. Summer Nuclear Station," WCAP-13480, Rev. 1, October 1993, the main steam and feedwater nozzles are fabricated from low-alloy steel and, therefore, not susceptible to FAC. Also there is no safe end for feedwater nozzle at VCSNS. The staff accepts the applicant's conclusion that loss of material due to FAC is not an applicable aging effect for the steam generator main steam nozzle and safe end, and feedwater nozzle because these components are made of low alloy steel and main steam exiting steam generator is dry.

In LRA Table 3.1-1, AMR Item 22, the applicant states that for steam generator bolting, loss of closure integrity rather than loss of preload or cracking is the aging effect requiring management. The staff issued RAI 3.1.2.4.7-5, requesting the applicant to explain how does the aging effect of loss of closure integrity in steam generator bolting differ from the effects of loss of material, loss of preload, and cracking. The staff had issued similar RAIs (RAI 3.1.2.4.2-1 and RAI 3.1.2.4.6-7) for bolting closures for Class 1 piping and the pressurizer. In its response to RAI 3.1.2.4.7-5, the applicant stated that loss of mechanical closure integrity can result in failure of the mechanical joint and its evidenced by leakage rather than joint failure. The applicant further states that this failure of mechanical joint can be attributed to loss of bolt preload, loss of bolting material by water, and cracking of high strength bolting material. Therefore, loss of closure integrity includes the effects of loss of preload, loss of material, and cracking of bolting materials. The staff concludes that the applicant has identified appropriate aging effect for the steam generator bolting and that management of loss of closure integrity includes management of three additional aging effects: loss of material, loss of preload, and cracking.

In LRA Table 3.1-1, AMR Item 32, the applicant identifies the aging effect of crack initiation and growth due to SCC and PWSCC for the channel head divider plate in the VCSNS steam generators. The staff issued RAI 3.1.2.4.7-6, requesting the applicant to confirm whether the weld on the divider plate is an Alloy 82/182 weld. In its response to RAI 3.1.2.4.7-6, in a letter dated June 12, 2003, the applicant states that the divider plate is welded with Alloy 82/182; however, the final pass was made with Alloy 52/152 so the weld does not have Alloy 82/182 exposed to borated water. The applicant further states that VCSNS has no evidence of cracking of the 52/152 welds since the installation of the replacement steam generators in the 1994 outage. The staff finds the applicant's response acceptable because the absence of cracking in these welds is consistent with the use of Alloy 52/152 weld metal for which industry experience has not revealed any cracking.

The aging effects identified in the LRA for the steam generator components in LRA Table 3.1-1 are consistent with GALL IV.D1, “Steam Generator (Recirculating).” The staff finds that the aging effects were identified.

Review of Aging Effects on Steam Generator-Related Items in LRA Table 3.1-2

In LRA Table 3.1-2, the applicant identifies the following additional aging effects for steam generator components exposed to secondary treated water. These aging effects are considered to be different from or are not addressed in GALL but are identified as a result of the applicant’s license renewal review.

11. loss of material in carbon steel components exposed to the treated secondary water/steam environment due to crevice corrosion, general corrosion, pitting corrosion, and galvanic corrosion

12. loss of material in various steam generator pressure boundary components due to crevice corrosion and pitting corrosion

13. loss of material in secondary-side thermal sleeves and the steam outlet nozzle flow limiter due to crevice corrosion and pitting corrosion

14. crack initiation and growth in secondary-side thermal sleeves and the steam outlet nozzle flow limiter due to stress corrosion cracking and flaw growth at welds (Item 9)

15. loss of material in the feedwater distribution pipe and fittings due to crevice and pitting corrosion

16. crack initiation and growth in the feedwater distribution pipe and fittings due to stress corrosion cracking

17. loss of material in stainless steel and nickel-based alloy components exposed to treated secondary water due to crevice and pitting corrosion; crack initiation and growth in these components due to SCC

In LRA Table 3.1-2, AMR Item 2, the applicant lists primary side nozzle safe ends that are made of austenitic stainless steel and exposed to an air-gas (moist air) environment. The applicant states that no aging effect or mechanism is identified for these components, since the ambient environment at VCSNS does not contain contaminants of sufficient concentration to cause aging effects requiring management. The staff agrees with the applicant’s conclusion that these materials are not expected to undergo any aging degradation in this environment.

In LRA Table 3.1-2, AMR Item 3, the applicant identifies loss of material as an applicable aging effect for carbon steel components (other than shell) exposed to secondary treated water. In addition, in LRA Table 3.1-2, AMR Items 8, 9, and 10, the applicant identifies loss of material and cracking as aging effects for stainless steel and low alloy steel components exposed to secondary treated water. The staff finds this identification of applicable aging effects acceptable because it is consistent with the similar identification in GALL IV.D1. For example, GALL Item IV.D1.1-c, identifies loss of material as an aging effect for carbon steel and low alloy steel components exposed to secondary treated water.

In LRA Table 3.1-2, AMR Item 7, the applicant identifies loss of material due to pitting and crevice corrosion as an aging effect for the primary side of manway cover insert plates made of stainless steel and exposed to chemically treated borated coolant. The staff finds this identification of loss of material as an aging effect acceptable because it is consistent with the similar identification in GALL IV.D1.

In LRA Table 3.1-2, AMR Item 11, the applicant identifies crack initiation and growth due to stress corrosion cracking on the primary side of manway cover insert plates exposed to chemically treated borated coolant. The staff finds this identification of cracking as an aging effect acceptable because it is consistent with the similar identification in GALL IV.D1.

The aging effects identified in the LRA for the steam generator components are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs:

As discussed in Section 3.1.2.4.7, the applicant identified five AMPs to manage the aging effects associated with the steam generator components. These AMPS are the steam generator management program, chemistry program, boric acid corrosion surveillances, in-service inspection plan, and the Alloy 600 aging management program.

The steam generator management program is an existing program credited with managing cracking and loss of material in steam generator tubes and plugs. The applicant states that this program is consistent with GALL AMP XI.M19, “Steam Generator Tube Integrity”. The staff has evaluated this AMP and, pending satisfactory resolution of the related RAIs, found it to be acceptable for managing the aging effects identified for the steam generator components. The staff’s evaluation of this AMP is documented in Section 3.1.2.3.7 of this SER.

The chemistry program manages water quality that is compatible with the materials of construction used in the Class 1 piping, steam generator components, and related components in order to minimize loss of material and cracking. This program incorporates EPRI and Institute of Nuclear Power Operations (INPO) guidelines, which reflect industry experience, and the “lessons learned” from VCSNS and external industry operating experience. The staff’s evaluation of this AMP is documented in Section 3.0.3.2 of this SER.

The boric acid corrosion surveillances program was developed by the applicant in response to NRC Generic Letter 88-05. Inspections are performed to provide reasonable assurance that borated water leakage from the reactor coolant pressure boundary does not lead to undetected loss of material on the external surface of carbon steel or low alloy steel bolting or other components. The staff’s evaluation of this AMP is documented in Section 3.0.3.1 of this SER.

The ISI plan manages aging effects of loss of material, cracking, and gross loss of preload for the RCS Class 1 steam generator pressure-boundary components and bolting. The scope of the ISI plan for these Class 1 components complies with the requirements of ASME Section XI, Subsection IWB. Depending on the examination category, the methods of inspections may include visual, surface and/or volumetric examination of weld locations susceptible to aging degradation. Subsection IWB specifies either inspect for loss of material and cracking in the

Class 1 components, or inspect for indications of reactor coolant leakage which, in the case of bolted connections, would be indicative of a loss of preload in the bolt. The staff's evaluation of this AMP is documented in Section 3.1.2.3.3 of this SER.

The Alloy 600 aging management program manages cracking in Alloy 600 cladding on the primary side of the tubesheet exposed to chemically treated borated coolant. As mentioned in Section 3.1.2.4.7, the primary side of the VCSNS steam generators does not have any other Alloy 600 components or Alloy 82/182 welds. The staff's evaluation of this AMP is documented in Section 3.1.2.3.1 of this SER.

Review of AMPs of Steam Generator-Related Items in LRA Table 3.1-1

In LRA Table 3.1-1, AMR Item 15, the applicant credits the steam generator management program and the chemistry program for managing the following three aging effects for Alloy 690 tubes and plugs: crack initiation and growth due to PWSCC, ODSCC, and IGA; loss of material due to wastage and pitting corrosion, and fretting and wear; and deformation due to corrosion at tube support plate intersections of tubes and plugs. The staff has evaluated this AMR results in Section 3.1.2.2.15 of this SER and concluded that the steam generator management program and chemistry program will manage the aging effects adequately during the period of extended operation.

In LRA Table 3.1-1, AMR Item 22, the applicant credits the in-service inspection plan for managing loss of closure integrity of steam generator class 2 bolting. The staff issued RAI 3.1.2.4.7-5, requesting the applicant to explain how the management of loss of closure integrity would ensure that loss of material, cracking, and loss of preload are managed. RAI 3.1.2.4.7-5, further requested the applicant to confirm whether bolt retorquing is performed at VCSNS as a part of its maintenance activities. In response to RAI 3.1.2.4.7-5, in a letter dated June 12, 2003, the applicant states that the bolts for steam generator closure are inspected following the ASME Section XI inspection guidelines during each inspection interval. This inspection will detect presence of loss of material and cracking and thus manage these aging effects. The applicant further states that the bolted connections are disassembled for scheduled inspection activities. Retorquing of the bolts to a proper preload during reassembly would ensure that the loss of preload present prior to disassembly is removed. Thus retorquing of the bolts following the inservice inspection manages loss of preload. The staff finds the applicant's response acceptable because the ISI plan will manage loss of closure integrity of steam generator bolting to ensures that loss of material, cracking, and loss of preload in steam generator closure bolts are managed properly.

In LRA Table 3.1-1, AMR Item 26, the applicant credits the boric acid corrosion surveillances for managing loss of material due to boric acid corrosion of external surfaces of carbon steel steam generator pressure boundary components. The staff finds this acceptable because the boric acid corrosion surveillances program has been evaluated in Section 3.0.3.1 of this SER and has been found, pending on satisfactory resolution of the any related RAIs, to be effective for the management of this aging effect in these components.

In LRA Table 3.1-1, AMR Item 32, the applicant credits the chemistry program in conjunction with the in-service inspection plan and the Alloy 600 aging management program with managing cracking due to SCC and PWSCC of lower heads, tubesheet, divider plate, and primary nozzles and safe ends. The staff finds that the three programs credited by the

applicant will be adequate for managing cracking in the components identified because the programs include mitigative program and condition monitoring programs. Also, these three programs are evaluated by the staff in Section 3.0.3 of this SER and are found to be effective for the management of this aging effect in these components. The staff issued RAI 3.1.2.4.7-7c, requesting the applicant to confirm whether the in-service inspection plan includes inspection of the weld between the divider plate and the tubesheet, since this region is potentially susceptible to SCC and PWSCC. In response to RAI 3.1.2.4.7-7c, in a letter dated June 12, 2003, the applicant confirmed that the inspection of the divider plate welds is included in the ISI plan. The staff finds the response acceptable because the ISI plan and the chemistry program will be adequate for managing cracking in the divider plate welds.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the steam generator components will effectively manage or monitor the aging effects identified in the LRA.

Review of AMPs of Steam Generator-Related Items in LRA Table 3.1-2

In LRA Table 3.1-2, AMR Item 3, the applicant discusses management of loss of material due to crevice, general, pitting, and galvanic corrosion in various carbon steel secondary-side steam generator components. These components include the manways and manway covers; handholes and handhole covers; sludge collector opening and inspection ports and port covers; secondary-side feedwater and emergency feedwater nozzles; blowdown, drain, level sample, and wet layup taps; tube bundle wrapper, wrapper support and downcomer; and secondary side of the tube plate. The applicant notes that these components are not specifically addressed in GALL Chapter IV and states that the chemistry program provides adequate management for these aging effects. The staff issued RAI 3.1.2.4.7-9, requesting the applicant to provide a condition-monitoring program to verify the effectiveness of the chemistry program in mitigating loss of material in these components. The staff also requested the applicant to confirm whether these components were included in the 100% inspection of the steam generator secondary side during Refueling Outage 12 as discussed in LRA Appendix B.1.10. In its response to RAI 3.1.2.4.7-9, in a letter dated June 12, 2003, the applicant refers to GALL AMP XI.M2, “Water Chemistry,” which states:

> The water chemistry programs are generally effective in removing impurities from intermediate and high flow areas. The GALL report identifies those circumstances in which the water chemistry program is to be augmented to manage the effects of aging for license renewal. For example, the water chemistry program may not be effective in low flow or stagnant flow areas. Accordingly, in certain cases as identified in the GALL report, verification of the effectiveness of the chemistry control program is undertaken to ensure that significant degradation is not occurring and the component intended function will be maintained during the extended period of operation.

The applicant further states that VCSNS steam generator components do not have low flow or stagnant areas to cause concern for the chemistry program not being effective. Therefore, the staff accepts that the applicant’s chemistry program is effective in managing loss of material in the VCSNS steam generator carbon steel components because it is consistent with GALL AMP XI.M2, “Water Chemistry.”

In RAI 3.1.2.2.2-1, the staff requested the applicant to identify all of the components inspected as part of the 100% secondary side inspection performed during Refueling Outage 12. In its response to RAI 3.1.2.2.2-1, the applicant described the steam generator secondary side components that were inspected: sludge collector, feedwater and emergency feedwater

nozzles, outside surface of the drain tube and tube supports, shroud surfaces, blowdown piping and supports, and secondary side of the tubesheet. The applicant states that these visual inspections did not detect any sign of erosion, corrosion, or degradation. The staff concludes that the inspection results confirm that the chemistry program is adequate for managing loss of material in the carbon steel components addressed by LRA Table 3.1-2, AMR Item 3.

In LRA Table 3.1-2, AMR Items 7, 8, 11, and 13, the applicant credits the chemistry program for managing loss of material in the following stainless steel and material components not specifically addressed in GALL Chapter IV:

- Crevice and pitting corrosion of stainless steel and nickel-based alloy channel head and inlet/outlet nozzles (stainless steel clad), channel head divider plate, manway cover insert plates (primary side), nozzle safe ends (primary side), inlet/outlet nozzles closure ring and weld metal, and tubesheet (primary side)

- Crevice and pitting corrosion of secondary-side thermal sleeves and steam flow limiter

- SCC of manway covers insert plates (primary side)

- Crevice and pitting corrosion, SCC of tube support plates, anti-vibration bars, flow distribution baffle

The staff concludes that the chemistry program is acceptable for managing the loss of material in stainless steel and nickel-based material components exposed to either chemically treated borated coolant or secondary treated coolant because stainless steel and nickel-based materials have good resistance to pitting and crevice corrosion.

In LRA Table 3.1-2, AMR Item 9, the applicant addresses crack initiation and growth due to SCC and flaw growth in welds in various thermally treated Alloy 690 steam generator components, including the secondary-side feedwater and emergency feedwater nozzle thermal sleeves and the steam outlet nozzle flow limiter. The applicant notes that these components are not specifically addressed in GALL Chapter IV and states that the chemistry program and the in-service inspection plan with the management of these aging effects. However, the staff notes that ASME Section XI, Article IWC-2000, Table IWC-2500-1, does not explicitly include the attachment welds for these components. The staff issued RAI 3.1.2.4.7-11, requesting the applicant to confirm whether the attachment welds for these components are included in the in-service inspection plan.

In its response to RAI 3.1.2.4.7-11, in a letter dated June 12, 2003, the applicant states that it credits only the chemistry program for managing cracking in these components. This response, however, contradicts the AMR results presented in LRA Table 3.1-2, Item 9. This RAI was further discussed with the applicant during the June 22, 2003, conference call. Based on the conference call, the applicant clarified its response to RAI 3.1.2.4.7-11, by stating that both the chemistry program and the ISI program manage cracking in thermally treated Alloy 690 components on the secondary side of the steam generators. In its additional response to RAI 3.1.2.4.7-11, in letter dated September 2, 2003, the applicant stated that the emergency feedwater piping and the first section of the main feedwater distribution piping that are welded to the steam generator nozzles act as thermal sleeves. The applicant also stated that its steam generator management program includes a visual inspection of the main feedwater distribution

piping, emergency feedwater piping, and the steam outlet nozzle flow limiter. The applicant stated further that LRA Table 3.1-2, Item 9, is incorrect by stating that the ISI program manages cracking in these components. The staff finds the applicant's response acceptable because these components are being managed for the applicable aging effects under the steam generator management program.

In LRA Table 3.1-2, AMR Item 10, the applicant credits the chemistry program in conjunction with the in-service inspection plan with managing loss of material due to crevice and pitting corrosion and cracking due to SCC of feedwater distribution pipe and fittings that are fabricated with alloy steel (chrome molybdenum). The staff was not clear about the type of inspection performed and was concerned about adequacy of this inspection for detecting loss of material and cracking that may take place at the inside surface of the feedwater distribution system. The staff issued RAI 3.1.2.4.7-12, requesting the applicant to confirm whether these components were included in the 100% inspection of the steam generator secondary side during Refueling Outage 12. In its response to RAI 3.1.2.4.7-12, in a letter dated June 12, 2003, the applicant states that the feedwater distribution components were inspected during Refueling Outage 12 and no abnormal indications were noted. The applicant also states that the chemistry program alone is adequate for managing the aging effects in feedwater distribution system pipe and fittings. This response, however, contradicts the AMR results presented in LRA Table 3.1-2, Item 10. This RAI was further discussed with the applicant during the June 22, 2003, conference call. Based on the conference call, the applicant clarified its response to RAI 3.1.2.4.7-12, by stating that both the chemistry program and the ISI program manage loss of material due to crevice and pitting corrosion and cracking due to SCC of the feedwater distribution pipe and fittings. However, the staff indicated that the applicant needs to confirm that the VCSNS ISI plan includes inspection of the feedwater distribution pipe and fittings.

In its additional response to RAI 3.1.2.4.7-11, in letter dated September 2, 2003, the applicant stated that the steam generator management program includes a visual inspection of the feedwater distribution pipe and fittings. The applicant stated further that LRA Table 3.1-2, Item 10, is incorrect by stating that the ISI program manages cracking in the feedwater distribution piping. The staff finds the applicant's response acceptable because the feedwater distribution piping and fittings are being managed for the applicable aging effects under the steam generator management program.

In LRA Table 3.1-2, AMR Item 13, the applicant discusses loss of material due to crevice and pitting corrosion and crack initiation and growth due to SCC in the tube support plates, anti-vibration bars, and flow-distribution baffle. These components are made of stainless steel or nickel-based alloys. The applicant states that the chemistry program provides adequate management for these aging effects, but does not provide a condition-monitoring program for verifying the effectiveness of the chemistry program. The staff issued RAI 3.1.2.4.7-13, requesting the applicant to submit technical basis showing adequacy of using the chemistry program for managing the aging effects. In its response to RAI 3.1.2.4.7-13, in a letter dated June 12, 2003, the applicant states that the accessible portions of these components were inspected during Refueling Outage 12 and no abnormal indications were noted. The applicant further states that use of the chemistry program is consistent with the operating experience conducted at VCSNS. The applicant also states that these components do not have low flow or stagnant areas. The staff finds the applicant's response acceptable because the results of the

inspections performed during Refueling Outage 12 verify the effectiveness of the chemistry program.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the steam generator components will effectively manage or monitor the aging effects identified in the LRA.

Conclusions

On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2 Engineered Safety Features Systems

This section addresses the aging management of the components of the engineered safety features systems group. The systems that make up the ESF system group are described in the following SER sections:

- chemical and volume control system (2.3.2.1)
- containment isolation system (2.3.2.2)
- hydrogen removal system (2.3.2.3)
- reactor building spray system (2.3.2.4)
- refueling water system (2.3.2.5)
- residual heat removal system (2.3.2.6)
- safety injection system (2.3.2.7)

As discussed in Section 3.0.1 of this SER, the components in each of these ESF systems are included in one of two LRA tables. LRA Table 3.2-1 consists of ESF system components that are evaluated in the GALL Report, and LRA Table 3.2-2 consists of ESF system components that are different from those address in the GALL Report or not addressed in it.

3.2.1 Summary of Technical Information in the Application

In LRA Section 3.2, the applicant described its AMRs for the ESF systems group at VCSNS. The description of the systems that comprise the ESF systems group can be found in LRA Section 2.3.2. The passive, long-lived components in these systems that are subject to an AMR are identified in LRA Tables 2.3-8 through 2.3-17.

The applicant's AMRs included an evaluation of plant-specific and industry operating experience. The plant-specific evaluation included reviews of condition reports and discussions with appropriate site personnel to identify aging effects that require management. These reviews concluded that the aging effects requiring management based on VCSNS operating experience were consistent with the aging effects identified in GALL.

The applicant's review of industry operating experience included a review of operating experience through 2002. The conclusions of this review were that the aging effects requiring management based on industry operating experience were consistent with the aging effects

identified in GALL. The applicant's ongoing review of plant-specific and industry-wide operating experience is conducted in accordance with the VCSNS Operating Experience Program.

3.2.2 Staff Evaluation

In Section 3.2 of the LRA, the applicant described its AMR for the ESF systems. The staff reviewed LRA Section 3.2 to determine whether the applicant had provided sufficient information to demonstrate that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB throughout the period of extended operation, in accordance with the requirements of 10 CFR 54.21(a)(3), for the ESF system components that are determined to be within the scope of license renewal and subject to an AMR. The applicant referenced the GALL Report in its AMR. The staff has previously evaluated the adequacy of the aging management of ESF system components for license renewal, as documented in the GALL Report. Thus, the staff did not repeat its review of the matters described in the GALL Report, except to ensure that the material presented in the LRA was applicable, and to verify that the applicant had identified the appropriate programs as described and evaluated in the GALL Report. The staff evaluated those aging management issues recommended for further evaluation in the GALL Report. The staff also reviewed aging management information submitted by the applicant that was different from that in the GALL Report or was not addressed in the GALL Report. Finally, the staff reviewed the UFSAR supplement to ensure that it provided an adequate description of the programs credited with managing aging for the ESF system components.

In LRA Section 3.2, the applicant provided brief descriptions of the ESF systems and summarized the results of its AMR of the ESF systems at VCSNS.

Table 3.2-1 below provides a summary of the staff's evaluation of components, aging effects/mechanisms, and AMPs listed in LRA Section 3.2 that are addressed in the GALL Report.

Table 3.2-1: Staff Evaluation for VCSNS Engineered Safety Features System Components in the GALL Report

Component Group	Aging Effect/Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
Piping, fittings, and valves in emergency core cooling system	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	TLAA	Consistent with GALL. GALL recommends further evaluation. (See Section 3.2.2.2.1 below.)
Piping, fittings, pumps, and valves in emergency core cooling system	Loss of material due to general corrosion	Water chemistry and one-time inspection	N/A	BWR
Components in containment spray (PWR only), standby gas treatment (BWR only), containment isolation, and emergency core cooling systems	Loss of material due to general corrosion	Plant-specific	Inspections for Mechanical Components Program; Chemistry Program	Consistent with GALL. GALL recommends further evaluation. (See Section 3.2.2.2.2 below.)

Table 3.2-1: Staff Evaluation for VCSNS Engineered Safety Features System Components in the GALL Report				
Component Group	**Aging Effect/Mechanism**	**AMP in GALL Report**	**AMP in LRA**	**Staff Evaluation**
Piping, fittings, pumps, and valves in emergency core cooling system	Loss of material due to pitting and crevice corrosion	Water chemistry and one-time inspection	N/A	BWR
Components in containment spray (PWR only), standby gas treatment (BWR only), containment isolation, and emergency core cooling systems	Loss of material due to pitting and crevice corrosion	Plant-specific	Inspections for Mechanical Components Program Chemistry Program	Consistent with GALL. GALL recommends further evaluation. (See Section 3.2.2.2.3 below.)
Containment isolation valves and associated piping	Loss of material due to MIC	Plant-specific	None	Not applicable to VCSNS. (See Section 3.2.2.2.4 below.)
Seals in standby gas treatment system	Changes in properties due to elastomer degradation	Plant-specific	N/A	BWR
High pressure safety injection (charging) pump miniflow orifice	Loss of material due to erosion	Plant-specific	None	Not applicable to VCSNS (See Section 3.2.2.2.5 below)
External surface of carbon steel components	Loss of material due to general corrosion	Plant-specific	Inspections for Mechanical Components Program	Consistent with GALL. GALL recommends further evaluation (See Section 3.2.2.2.6 below.)
Drywell and suppression chamber spray system nozzles and flow orifices	Plugging of nozzles and flow orifices due to general corrosion	Plant-specific	N/A	BWR
Piping and fittings of CASS in emergency core cooling system	Loss of fracture toughness due to thermal aging embrittlement	Thermal aging embrittlement CASS	None	Not applicable to VCSNS. (See Section 3.2.2.1 below.)
Components serviced by open-cycle cooling system	Local loss of material due to corrosion and/or buildup of deposit due to biofouling	Open-cycle cooling water system	N/A	Not applicable to the ESF components at VCSNS. (See Section 3.2.2.1 below.)
Components serviced by closed-cycle cooling system	Loss of material due to general, pitting, and crevice corrosion	Closed-cycle cooling water system	Chemistry Program	Consistent with GALL. (See Section 3.2.2.1 below.)
Emergency core cooling system valves and lines to and from HPCI and RCIC pump turbines	Wall thinning due to FAC	Flow-accelerated corrosion	N/A	BWR

Table 3.2-1: Staff Evaluation for VCSNS Engineered Safety Features System Components in the GALL Report				
Component Group	**Aging Effect/Mechanism**	**AMP in GALL Report**	**AMP in LRA**	**Staff Evaluation**
Pumps, valves, piping, and fittings in containment spray and emergency core cooling systems	Crack initiation and growth due to SCC	Water chemistry	Chemistry Program	Consistent with GALL (See Section 3.2.2.1 below)
Pumps, valves, piping, and fittings in emergency core cooling systems	Crack initiation and growth due SCC and IGSCC	Water chemistry and BWR stress corrosion cracking	N/A	BWR
Carbon steel components	Loss of material due to boric acid corrosion	Boric acid corrosion	Boric Acid Corrosion Surveillances Program	Consistent with GALL. (See Section 3.2.2.1 below.)
Closure bolting in high pressure or high temperature systems	Loss of material due to general corrosion, loss of preload due to stress relaxation, and crack initiation and growth due to cyclic loading or SCC	Bolting integrity	Bolting Integrity Program	Loss of mechanical closure integrity is not considered an aging effect requiring evaluation for non-Class 1 component bolted closures. The specific bolting/fastener materials of subject component types were not itemized separately, but were treated as a "piece-part" of non-Class 1 components/ component type.

3.2.2.1 Aging Management Evaluations in the GALL Report That Are Relied On for License Renewal, That Do Not Require Further Evaluation

For component groups evaluated in GALL for which the applicant claimed consistency with GALL, and for which GALL does not recommend further evaluation, the staff sampled components in these groups to determine whether the plant-specific components contained in these groups were bounded by the GALL evaluation. The staff also sampled component groups to determine whether the applicant had properly identified those component groups in GALL that were not applicable to its plant. The staff also identified several areas for which additional information or clarification was needed. The staff's evaluation of the applicant's responses to those RAIs is included in Section 3.2.2.4 of this SER.

On the basis of its review of the inspection results, the staff has verified the applicant's claim of consistency with the GALL report. The staff finds that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended

functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.2.2 Aging Management Evaluations in the GALL Report That Are Relied on for License Renewal, For Which GALL Recommends Further Evaluation

For component groups evaluated in GALL for which the applicant has claimed consistency with GALL, and for which GALL recommends further evaluation, the staff reviewed the applicant's evaluation to determine whether it adequately addressed the issues for which GALL recommended further evaluation. In addition, the staff sampled components in these groups during the review to determine whether the plant-specific components contained in these groups were bounded by the GALL evaluation.

The GALL Report indicates that further evaluation should be performed for the aging effects discussed in the following sections.

3.2.2.2.1 Cumulative Fatigue Damage

The GALL Report identifies that fatigue is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). The staff reviewed the evaluation of this TLAA in Section 4.3 of this SER, following the guidance in Section 4.3 of the SRP-LR.

The applicant indicated that all TLAAs, including those for the Class 1 components of the ESF systems, were evaluated in the RCS section of the LRA. The applicant discussed the TLAA in Section 4.3 of the LRA, "Metal Fatigue." This TLAA is evaluated in Section 4.3 of this SER.

3.2.2.2.2 Loss of Material Due to General Corrosion

Loss of material due to general corrosion could occur in the containment spray system header and spray nozzle components and the external surfaces of PWR carbon steel components. The GALL Report recommends further evaluation on a plant-specific basis to ensure that the aging effect is adequately managed. The staff reviewed the applicant's proposed programs to ensure that an adequate program will be in place for the management of general corrosion of these components.

The applicant indicated in LRA Table 3.2-1, Item 2, that the VCSNS containment spray system is made of stainless steel, rather than carbon steel, and, therefore, is not covered by GALL. Four systems at VCSNS have been identified whose only license renewal function is to provide containment isolation. These systems included the auxiliary coolant (closed loop)/CRDM cooling water (AC), demineralized water—nuclear service (DN), reactor building leak rate testing (LR), and nitrogen blanketing (NG). Among them, the AC, LR, and NG systems contain carbon steel components that are in scope. The applicant stated that the Inspections for Mechanical Components Program (LRA Appendix B.2.11) is credited for detecting and managing the loss of material due to general corrosion on the external surfaces of carbon steel components. The air-gas environments inside LR and NG components do not contain contaminants of sufficient concentration to cause general corrosion severe enough to warrant managing. The Chemistry Program (LRA Appendix B.1.4) is credited with providing aging management of corrosion of the interior of AC system components. Consistent with the GALL

Report, this group contains carbon steel in ambient air and treated water environments. Additionally, compressed gas is also included in this group. The staff evaluation of the Chemistry Program and the Inspections for Mechanical Components Program is documented in Sections 3.0.3.2 and 3.0.3.7, respectively, of this SER.

The staff reviewed the applicant's proposed programs and concludes that, based on the program descriptions of LRA Appendix B.1.4 and Appendix B.2.11, general corrosion is not occurring and the component intended functions will be maintained during the period of extended operation. The staff verified that the applicant's AMPs are sufficient to manage the identified aging effect of loss of material due to general corrosion.

On the basis of its review, the staff finds that the applicant has appropriately evaluated AMR results involving management of the loss of material due to general corrosion, as recommended in the GALL Report. Since the applicant's AMR results are otherwise consistent with the GALL report, the staff finds that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.2.2.3 Local Loss of Material Due to Pitting and Crevice Corrosion

Local loss of material from pitting and crevice corrosion could occur in containment spray components, containment isolation valves and associated piping, and buried portions of the refueling water tank external surface. The GALL Report recommends further evaluation to ensure that the aging effect is adequately managed. The staff reviewed the applicant's proposed programs to ensure that an adequate program will be in place for the management of local loss of material due to pitting and crevice corrosion of these components.

In LRA Table 3.2-1, Item 3, the applicant stated that this group contains the refueling water storage tank and systems whose only license renewal function is to provide containment isolation. The four systems identified to provide the containment isolation function are AC, DN, LR and NG. The Inspections for Mechanical Components Program is credited for detecting and managing the loss of material due to pitting, crevice, and galvanic corrosion on the surfaces of carbon steel components. As in Section 3.2.2.2.2 of this SER, the Chemistry Program is credited with providing aging management of corrosion of the interior of AC and DN system components. The staff evaluation of the Chemistry Program and the Inspections for Mechanical Components Program is documented in Sections 3.0.3.2 and 3.0.3.7, respectively, of this SER.

Based on its review of LRA Appendix B.1.4 and Appendix B.2.11, the staff finds that pitting and crevice corrosion is not occurring and that the component intended functions will be maintained during the period of extended operation. The staff verified that the applicant's AMPs are sufficient to manage the identified aging effect of loss of material due to pitting and crevice corrosion.

In LRA Table 3.2-1, Item 3, the applicant stated that loss of material of the underside of the RWST is not an aging effect requiring management because this stainless steel tank is not buried. In RAI 3.2-1, the staff requested the applicant to discuss the potential corrosive environments surrounding the tank bottom, and justify its determination that there are no aging effects requiring management. By letter dated June 12, 2003, the applicant stated that the 1 in. stainless steel RWST bottom at VCSNS sits on an outdoor raised concrete foundation that

ensures that the tank bottom is not subjected to flowing water. The applicant stated that VCSNS is located well inland and does not see salt or other corrosive materials in the air. The stainless steel tank bottom is in a low temperature (less than 140 °F) environment similar to stainless steel embedded in concrete. This environment has been determined not to have aging effects requiring management. Based on the environments presented by the applicant and the general industry experience, the staff finds the applicant's AMR evaluation to be acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated AMR results involving management of the local loss of material due to pitting and crevice corrosion, as recommended in the GALL Report. Since the applicant's AMR results are otherwise consistent with the GALL report, the staff finds that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.2.2.4 Local Loss of Material Due to Microbiologically Influenced Corrosion

Local loss of material due to MIC could occur in PWR containment isolation valves and associated piping in systems that are not addressed in other chapters of the GALL Report. The GALL Report recommends further evaluation to ensure that the aging effect is adequately managed. The staff reviewed the applicant's proposed programs to ensure that an adequate program will be in place for the management of local loss of material due to MIC of the containment isolation barriers.

In LRA Table 3.2-1, Item 4, the applicant stated that MIC is not a valid aging mechanism for the material/environment combination represented by the containment isolation valves and associated piping. The applicant stated that this aging mechanism is not applicable since the four systems (AC, DN, LR, NG) which provide containment isolation are not subject to wetting from raw water. In RAI 3.2-2, the staff requested the applicant to provide details of the physical environments that are associated with the containment isolation valves and associated piping, for each of the four systems, and justify that these components are not susceptible to loss of material due to MIC. By letter dated June 12, 2003, the applicant stated that, with the exception of the reactor building equipment hatch, the reactor building penetrations at VCSNS are located indoors. The containment isolation systems contain either treated water or air/gas. AC is a treated water cooling water system. DN contains demineralized water. LR and NG contain air/gas. The in-scope portions of these systems are in a sheltered environment and are not exposed to rain or raw water. Therefore, loss of material due to MIC is not a valid aging effect for the in-scope portion of these systems. The staff finds the applicant's response to be adequate in justifying that MIC is not a valid aging mechanism for the above containment isolation components. Therefore, no AMP is required.

On the basis of its review, the staff finds that the applicant has appropriately evaluated AMR results involving management of loss of material due to MIC, as recommended in the GALL Report. Since the applicant's AMR results are otherwise consistent with the GALL report, the staff finds that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.2.2.5 Local Loss of Material Due to Erosion

Local loss of material due to erosion could occur in the high pressure safety injection pump miniflow orifice. This aging mechanism and effect will apply only to pumps that are normally used as charging pumps in the chemical and volume control systems. The GALL Report recommends further evaluation to ensure that the aging effect is adequately managed for these components. The staff reviewed the applicant's proposed programs to ensure that an adequate program will be in place to manage this aging effect.

The identified GALL item for high pressure safety injection (charging) pump mini flow orifices recommends a plant-specific evaluation of the credited program. The applicant stated in LRA Table 3.2-1, Item 5, that VCSNS considers this aging effect/mechanism a design problem, and does not have an identified AMP for the erosion of mini flow orifices. In RAI 3.2-4, the staff requested the applicant to elaborate on this stated design problem. By letter dated June 12, 2003, the applicant stated that the VCSNS high pressure safety injection pump (charging pump) mini flow orifices are made of stainless steel stock with a drilled hole approximately 12 in. long. The applicant stated that this design will be capable of preventing erosion from becoming an aging concern that requires evaluation for the orifices. Based on the plant-specific design of the high pressure safety injection (charging) pump mini flow orifices, the staff finds the orifices not to be susceptible to significant loss of material due to erosion. Therefore, no AMP is required.

On the basis of its review, the staff finds that the applicant has appropriately evaluated AMR results involving management of loss of material due to erosion, as recommended in the GALL Report. Since the applicant's AMR results are otherwise consistent with the GALL report, the staff finds that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.2.2.6 Loss of Material Due to General Corrosion

Loss of material due to general corrosion could occur in the external surfaces of carbon steel pipes and fittings, primary containment penetrations, and valve bodies of the containment penetrations and system interface system. This component type is only found in Table 2 of GALL (NUREG-1801, Volume 1). It is not found in Table 3.2-1 of The SRP-LR (NUREG-1800). The GALL Report recommends further evaluation on a plant-specific basis to ensure that loss of material is adequately managed for these components. The staff reviewed the applicant's proposed programs to ensure that an adequate program will be in place for the management of general corrosion of these components.

In LRA Table 3.2-1, Item 6, the applicant stated that for the external surface of carbon steel components at VCSNS, the AMR results are consistent with GALL in material, environment, aging effect, and credited program. In addition to carbon steel, VCSNS has included cast iron in this group. The applicant credited the Inspections for Mechanical Components Program (Appendix B.2.11) for managing the aging effect of loss of material due to general corrosion for the above carbon steel components. The staff evaluation of this AMP is documented in Section 3.0.3.7 of this SER.

The staff reviewed the applicant's Inspections for Mechanical Components Program to ensure that corrosion is not occurring and that the component intended function will be maintained during the period of extended operation. The staff verified that the applicant's AMP is sufficient to manage the identified aging effect of loss of material due to general corrosion.

On the basis of its review, the staff finds that the applicant has appropriately evaluated AMR results involving management of loss of material due to general corrosion, as recommended in the GALL Report. Since the applicant's AMR results are otherwise consistent with the GALL report, the staff finds that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.2.3 Aging Management Programs for Engineered Safety Features Systems Components

In SER Section 3.2.2.1, the staff evaluated the applicant's conformance with the aging management recommended by GALL for ESF systems. In SER Section 3.2.2.2, the staff reviewed the applicant's evaluation of the issues for which GALL recommends further evaluation. In this SER section, the staff presents its evaluation of the programs used by the applicant to manage the aging of the component groups within the ESF systems.

The applicant credits five AMPs to manage the aging effects associated with components in the ESF systems. All five AMPs are credited to manage aging for components in other system groups (common AMPs). The staff's evaluation of the common AMPs that are credited with managing aging in ESF system components is provided in Section 3.0.3 of this SER. The common AMPs credited for ESF components are as follows:

- Boric Acid Corrosion Surveillances Program (3.0.3.1)
- Chemistry Program (3.0.3.2)
- Above Ground Tank Inspection Program (3.0.3.5)
- Inspection for Mechanical Components Program (3.0.3.7)
- Heat Exchanger Inspections Program (3.0.3.8)

There are no AMPs that are specific to ESF systems.

3.2.2.4 Aging Management Review of Plant-Specific Engineered Safety Features Systems Components

In this section of the SER, the staff presents its review of the applicant's AMR for specific components within the ESF systems. To perform its evaluation, the staff reviewed the components listed in LRA Tables 2.3-8 through 2.3-17 to determine whether the applicant had properly identified the applicable aging effects and the AMPs needed to adequately manage these aging effects. This portion of the staff's review involved identification of the aging effects for each ESF component, ensuring that each aging effect was evaluated in the appropriate LRA AMR Table in Section 3, and that management of the aging effect was captured in the appropriate AMP. The results of the staff's review are provided in the sections that follow.

3.2.2.4.1 Chemical and Volume Control System

<u>Summary of Technical Information in the Application</u>

The description of the chemical and volume control system can be found in Section 2.3.2.1 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3-8. The components, aging effects, and AMPs are provided in LRA Tables 3.2-1 and 3.2-2.

Aging Effects:

Components of the chemical and volume control system are described in LRA Section 2.3.2.1 as being within the scope of license renewal and subject to an AMR. Table 2.3-8 of the LRA lists individual components of the system, including agitators and mixers, demineralizers, filters, flexible couplings, gearboxes, heat exchanger (channel head), heat exchangers (shell), heat exchanger (tubes), heat exchanger (tubesheet), instrumentation (pressure retaining only), oil reservoir, orifices, pipe, pumps (bearing houses), pump (casing only), tanks, tube and tube fittings, and valves (body only).

Stainless steel components are identified as being subject to loss of material due to crevice corrosion, pitting corrosion, and cracking due to SCC in borated or treated water environments. No aging effects are identified for stainless steel components in sheltered, reactor building, ventilation, or lube oil environments.

Carbon steel components are identified as being subject to loss of material due to boric acid corrosion (aggressive chemical attack) in sheltered or reactor building environments. Carbon steel components are identified as being subject to loss of material due to general corrosion in sheltered or reactor building environments. Carbon steel components are identified as being subject to loss of material due to crevice, galvanic, general, and pitting corrosion in treated water environments. No aging effects are identified for carbon steel components in lube oil environments.

Cast iron components are identified as being subject to loss of material due to general corrosion in sheltered environments. Cast iron components are identified as being subject to loss of material due to boric acid corrosion (aggressive chemical attack) in sheltered environments. No aging effects are identified for cast iron components in lube oil environments.

Copper-nickel components are identified as being subject to loss of material due to crevice, pitting, and galvanic corrosion, and erosion-corrosion. Copper components are identified as being subject to loss of material due to boric acid corrosion (aggressive chemical attack) in sheltered environments. No aging effects are identified for copper or copper-nickel components in lube oil environments.

No aging effects are identified for glass components in lube oil or sheltered environments.

Aging Management Programs:

The following AMPs are utilized to manage aging effects in the chemical and volume control system:

- Boric Acid Corrosion Surveillances Program
- Chemistry Program
- Inspection for Mechanical Components Program
- Heat Exchanger Inspections Program

A description of these AMPs is provided in Appendix B of the LRA. The applicant states that the effects of aging associated with the components of the chemical and volume control system will be adequately managed by these AMPs during the period of extended operation.

Staff Evaluation

Aging Effects:

The staff reviewed the information in LRA Tables 2.3-8, 3.2-1, and 3.2-2 for the chemical and volume control system. During its review, the staff determined that additional information was needed.

In LRA Table 3.2-2, Item 1, the applicant stated that sheltered environments do not contain contaminants of sufficient concentration to cause aging effects requiring management. In RAI 3.2-3, the staff requested the applicant to provide the basis, for all potential sheltered environments in the ESF systems, that stainless steel components are not susceptible to any aging effects requiring management. By letter dated June 12, 2003, the applicant stated that VCSNS is located well inland and is in an area where forestry is the prime commercial activity. VCSNS does not see salt or other corrosive materials in the air from agriculture or industry. Samples of ground water and rainwater show chloride and sulfate concentrations less than 10 parts per million (ppm). Based on this insignificant concentration of chloride and sulfate in the air environment, and the fact that industry experiences identified no aging effects requiring management for the external surface of stainless steel components in a gas environment, the staff finds the applicant's evaluation presented in LRA Table 3.2-2, Item 1, to be acceptable.

In RAI 3.2-4, the staff requested the applicant to provide its plant-specific design information of the high pressure safety injection pump mini flow orifice, included in LRA Table 3.2-1, Item 5, and the procedure in place to resolve the design problem involving loss of material due to erosion. The staff's discussion of this RAI and its resolution by the applicant is provided in Section 3.2.2.2.5 of this SER.

In LRA Table B-1, the applicant stated that the Bolting Integrity Program of GALL (XI.M18) is not credited for aging management. In LRA Tables 2.3-8 through 2.3-17, the applicant did not list closure bolting for the ESF systems as a separate component type requiring AMR review. Also, in Table 3.2-1, Item 12, the applicant stated that loss of mechanical closure integrity is not considered an aging effect requiring evaluation for non-Class 1 component bolted closures. The applicant further stated that the bolting/fasteners within the scope of license renewal were not itemized as a separate non-Class 1 component/component type. Rather, the bolting was treated as a subcomponent/subpart of non-Class 1 components/component types. In RAI 3.2-6, the staff requested the applicant to provide the basis for not considering loss of mechanical closure integrity an aging effect, and to discuss the plant-specific AMR of closure bolting, in reference to the intent of GALL XI.M18, "Bolting Integrity." By letter dated June 12, 2003, the applicant stated that, for all non-Class 1 bolted closures (i.e., pressure retaining) of components/component types subject to AMR, the design of critical closure joint bolting involves enough redundancy to ensure joint integrity. Therefore, no aging effects unique to bolting, over the components being joined/closed, require evaluation for license renewal, as discussed below.

The applicant stated that mechanical components within the scope of license renewal, both Class 1 and non-Class 1, contain bolted closures that are necessary for the pressure boundary of the components being joined/closed. These bolted closures, which are composed of two mating surfaces, a gasket, and a fastener set, form an integral part of the pressure-retaining boundary of the components. Additionally, the bolted closure is exposed to the same environment(s) as the components in the plant areas where the closure is located (process fluid for internal mating surface and ambient conditions else). As such, the bolted closure (including fastener set) was considered to be a subcomponent of the components/component types within the scope of license renewal and, except as clarified, did not require evaluation separate from the component.

The applicant stated that loss of mechanical closure integrity, which can result in failure of the mechanical joint, is evidenced by leakage rather than joint failure, and can be attributed to one or more of the following effects:

- loss of bolt preload (embedment, cyclic load embedment, gasket creep, etc.)
- loss of bolting material (from general and/or boric acid corrosion)
- reduction of bolting material fracture toughness
- cracking of high-strength bolting material (SCC)

The applicant stated that for non-Class 1 bolted closures, loss of preload was considered to be the result of inadequate design or improper assembly (i.e., event-driven) that is not related to aging and that would manifest itself during the current operating term and be corrected prior to the period of extended operation. Thus, the mechanisms associated with loss of bolting pre-load are not a license renewal concern for non-Class 1 components/component types.

It is recognized that loss of bolting material could ultimately result in the loss of a component’s pressure boundary integrity and, thus, requires evaluation for license renewal. The applicant stated, however, that loss of material is an aging effect requiring license renewal evaluation for carbon and alloy steel components/component types subject to AMR. As such, no evaluation, separate from the subject components/component types of which bolted closures are a part, is necessary and, for carbon and alloy steel components/component types, the AMPs credited for managing external general corrosion will also inherently address their fasteners.

The applicant stated that loss of material due to boric acid wastage (aggressive chemical attack) is the most common aging effect that has been observed in the industry for ferrite fasteners. In the concentrations used in PWR systems, boric acid is a relatively weak acid. However, under wetting and drying conditions, such as a result of leakage, boric acid may concentrate in slurry forming a saturated solution. Stainless steel fasteners have been shown not to be susceptible to loss of material due to boric acid wastage, however. The appropriate program/activities credited for management of the external aging of carbon and low-alloy steel in locations susceptible to leaking borated water will also address carbon and low-alloy steel fasteners in that location. Additionally, the applicant noted that AMPs credited for addressing boric acid wastage will also inherently address any general corrosion concerns for carbon or low-alloy steel bolting of stainless steel components/component types.

The applicant stated that reduction of fracture toughness of bolting material due to thermal/neutron effects is a license renewal concern for the fasteners of components because of elevated system operating temperatures and proximity to the reactor vessel beltline region.

This is applicable to bolting of some Class 1 components and is addressed in the application. Reduction of fracture toughness for non-Class 1 bolting material is not a license renewal aging effect requiring management for the fasteners of components.

Regarding the SCC of bolting materials, the applicant stated that, although there have been a few instances of cracking of bolting in the industry due to SCC, these have been attributed to high yield strength materials and contaminants, such as the use of lubricants containing MoS_2 . VCSNS does not use lubricants containing MoS_2 and, in general, environmental conditions that could lead to SCC of bolting are not expected to occur in non-Class 1 components. For quenched and tempered low-alloy steels used for closure bolting (e.g., ASTM A193 Grade B7), material susceptibility to SCC is minimized by having a lower yield strength. EPRI Report NP-5769 (Volume I, page 11-5) indicates that SCC should not be a concern for closure bolting in nuclear power plant applications if the specified yield strength is below 150 ksi. The specification for the fabrication of nuclear piping specifies alloy steel ASTM A193, Grade B7 bolts/studs and ASTM A194, Grade 2H nuts, which have minimum yield strengths below 150 ksi (105 ksi). In addition to the use of appropriate material as stated above, sound maintenance bolt torquing practices can control bolting material stresses and help reduce the potential for SCC to occur. The applicant stated that a review of industry failure databases and NRC generic communications supports the fact that proper material selection, proper maintenance and torquing procedures, and removal of contaminants from lubricants have been effective in eliminating the potential for SCC of bolting materials. Therefore, SCC of bolting materials is not an aging effect requiring evaluation for license renewal for non-Class 1 components/component types.

The staff has reviewed the applicant’s response as presented in its letter of June 12, 2003, and finds that the applicant has adequately addressed all the issues raised by the staff in RAI 3.2-6. Specifically, the staff finds that the applicant has adequately explained that the aging effects/mechanisms of the bolted closure can be evaluated as a part of the aging effects/ mechanisms of the components to which it connects because of the similarity of the exposed environments. The applicant also adequately explained that loss of mechanical closure integrity is not an aging effect requiring evaluation for non-Class 1 component bolted closures because the creditable attributes which could potentially lead to joint leakage (such as loss of bolt preload, loss of bolting material, reduction of bolting material fracture toughness, and cracking of high-strength bolting material (SCC)) are not considered aging effects/ mechanisms requiring evaluation for license renewal for non-Class 1 components/component types of ESF systems. Based on the above, the staff finds the applicant’s response to be acceptable.

The aging effects identified in the LRA for the components in the chemical and volume control system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environment specified.

Aging Management Programs:

The applicant credited the following AMPs for managing the aging effects in the chemical and volume control system:

- Boric Acid Corrosion Surveillances Program
- Chemistry Program

- Inspections for Mechanical Components Program
- Heat Exchanger Inspections Program

These AMPs are credited for managing the aging effects of several components in other structures and systems and are, therefore, considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Sections 3.0.3.1, 3.0.3.2, 3.0.3.7, and 3.0.3.8, respectively, of this SER.

In LRA Table 3.3-1, Item 8, relative to stainless steel heat exchangers in the chemical and volume control system, the applicant stated that the Water Chemistry Program is credited for managing the aging effect of crack initiation and growth due to SCC. The applicant stated that the Chemistry Program has been in effect since initial plant startup and has proven effective in maintaining system chemistry and in detecting abnormal conditions. A review of the operating experience also confirms its effectiveness in managing aging effects. The applicant stated, therefore, that a verification program, as recommended by GALL, is not warranted for these components/component types. The staff finds the applicant's statement to be acceptable. This determination is based on the successful operating experience of these heat exchangers, the effectiveness of the Chemistry Program in maintaining system chemistry (such as oxygen, chlorides, fluorides, and/or sulfates), and the fact that heat exchangers in the chemical and volume control system are always in a fluid-solid (filled and vented) condition during normal operation. Therefore, loss of material and cracking need not be considered as aging effects requiring management due to the corrosive impacts of alternate wetting and drying for stainless steel components exposed to borated water and treated water environments.

After evaluating the applicant's AMR for each of the components in the chemical and volume control system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects. For those components identified in Table 3.2-1 of the LRA, the staff verified that the applicant credited the AMP recommended by the GALL Report. For the components identified in LRA Table 3.2-2, the staff verified that the applicant credited an AMP that is appropriate for the identified aging effects.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the components of the chemical and volume control system will effectively manage or monitor the aging effects identified in the LRA.

Conclusions

On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.2.4.2 Containment Isolation System

Summary of Technical Information in the Application

The description of the containment isolation system can be found in Section 2.3.2.2 of this SER. Four systems at VCSNS have been identified whose only mechanical license renewal function is to provide containment isolation. These four systems include the following:

- auxiliary coolant (closed loop)/CRDM cooling water system
- demineralized water—nuclear service system
- reactor building leak rate testing system
- nitrogen blanketing system

The passive, long-lived components in the containment isolation system that are subject to an AMR are identified in LRA Tables 2.3-9 through 2.3-12. The components, aging effects, and AMPs are provided in LRA Tables 3.2-1 and 3.2-2.

Aging Effects:

Components of the containment isolation system are described in LRA Section 2.3.2.2 as being within the scope of licence renewal and subject to an AMR. Tables 2.3-9 through 2.3-12 of the LRA list individual components of the system including pipe and valves (body only).

Stainless steel components are identified as being subject to loss of material due to crevice and pitting corrosion in treated water environments. No aging effects are identified for stainless steel components in reactor building or sheltered environments.

Carbon steel components are identified as being subject to loss of material due to general corrosion in reactor building or sheltered environments. Carbon steel components are identified as being subject to loss of material due to crevice, galvanic, general, and pitting corrosion in treated water environments. Carbon steel components are identified as being subject to loss of material due to boric acid corrosion (aggressive chemical attack) in reactor or sheltered environments. No aging effects are identified for carbon steel components in air-gas (dry) or ventilation environments.

Aging Management Programs:

The following AMPs are utilized to manage aging effects in the containment isolation system:

- Boric Acid Corrosion Surveillances Program
- Chemistry Program
- Inspections for Mechanical Components Program

A description of these AMPs is provided in Appendix B of the LRA. The applicant concluded that the effects of aging associated with the components of the containment isolation system will be adequately managed by these AMPs during the period of extended operation.

<u>Staff Evaluation</u>

Aging Effects:

The staff reviewed the information in LRA Tables 2.3.9 through 2.3.12, 3.2-1, and 3.2-2 for the containment isolation system. During its review, the staff determined that additional information was needed.

In RAI 3.2-1, the staff requested the applicant to discuss the potential corrosive environments surrounding the RWST bottom, as stated in LRA Table 3.2-1, Item 3, and justify its determination that there are no aging effects requiring management. The staff discussion of this RAI and its resolution by the applicant is provided in Section 3.2.2.2.3 of this SER.

In RAI 3.2-6, the staff requested the applicant to provide the basis for not considering loss of mechanical closure integrity an aging effect (as stated in LRA Table 3.2-1, Item 12), and to discuss the plant-specific AMR of closure bolting, in reference to the intent of GALL XI.M18, “Bolting Integrity.” The staff’s discussion of this RAI and its resolution by the applicant is provided in Section 3.2.2.4.1 of this SER.

The aging effects identified in the LRA for the components in the containment isolation system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Program:

The applicant credited the following AMPs for managing the aging effects in the containment isolation system:

- Boric Acid Corrosion Surveillances Program
- Chemistry Program
- Inspections for Mechanical Components Program

These AMPs are credited for managing the aging effects of several components in other structures and systems and are, therefore, considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff’s evaluation of these AMPs is documented in Sections 3.0.3.1, 3.0.3.2, and 3.0.3.7, respectively, of this SER.

After evaluating the applicant’s AMR for each of the components in the containment isolation system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects. For those components identified in Table 3.2-1 of the LRA, the staff verified that the applicant credited the AMP recommended by the GALL Report. For the components identified in LRA Table 3.2-2, the staff verified that the applicant credited an AMP that is appropriate for the identified aging effects.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the components of the containment isolation system will effectively manage or monitor the aging effects identified in the LRA.

<u>Conclusions</u>

On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.2.4.3 Hydrogen Removal — Post Accident System

Summary of Technical Information in the Application

The description of the hydrogen removal—post accident system can be found in Section 2.3.2.3 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3-13. The components, aging effects, and AMPs are provided in LRA Tables 3.2-1 and 3.2-2.

Aging Effects:

Components of the hydrogen removal — post accident system are described in LRA Section 2.3.2.3 as being within the scope of license renewal and subject to an AMR. Table 2.3-13 of the LRA lists individual components of the system including hydrogen recombiners (electric), pipe, tubing, and valves (body only).

Carbon steel components are identified as being subject to loss of material due to general corrosion in sheltered or reactor building environments. Carbon steel components are identified as being subject to loss of material due to boric acid corrosion (aggressive chemical attack) in reactor building or sheltered environments. No aging effects are identified for carbon steel components in air-gas (dry) environments.

No aging effects are identified for stainless steel components in reactor building, sheltered, or air-gas (dry) environments. No aging effects are identified for nickel-based alloys (Inconel 600 and Incoloy 800) in reactor building environments.

Aging Management Programs:

The following AMPs are utilized to manage aging effects in the hydrogen removal—post accident system:

- Boric Acid Corrosion Surveillances Program
- Inspections for Mechanical Components Program

A description of these AMPs is provided in Appendix B of the LRA. The applicant concluded that the effects of aging associated with the components of the hydrogen removal—post accident system will be adequately managed by these AMPs during the period of extended operation.

Staff Evaluation

Aging Effects:

The staff reviewed the information in LRA Tables 2.3.13, 3.2-1, and 3.2-2 for the hydrogen removal—post accident system. During its review, the staff determined that additional information was needed.

In RAI 3.2-1, the staff requested the applicant to discuss the potential corrosive environments surrounding the RWST bottom, as stated in LRA Table 3.2-1, Item 3, and justify its determination that there are no aging effects requiring management. The staff's discussion of this RAI and its resolution by the applicant is provided in Section 3.2.2.2.3 of this SER.

In RAI 3.2-3, the staff requested the applicant to provide the basis, for all potential sheltered environments in the ESF systems, that stainless steel components are not susceptible to any aging effects requiring management, as stated in LRA Table 3.2-2, Item 1. The staff's discussion of this RAI and its resolution by the applicant is provided in Section 3.2.2.4.1 of this SER.

In RAI 3.2-6, the staff requested the applicant to provide the basis for not considering loss of mechanical closure integrity an aging effect (as stated in LRA Table 3.2-1, Item 12), and to discuss the plant-specific AMR of closure bolting, in reference to the intent of GALL XI.M18, "Bolting Integrity." The staff's discussion of this RAI and its resolution by the applicant is provided in Section 3.2.2.4.1 of this SER.

The aging effects identified in the LRA for the components in the hydrogen removal—post accident system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs:

The applicant credited the following AMPs for managing the aging effects in the hydrogen removal—post accident system:

- Boric Acid Corrosion Surveillances Program
- Inspections for Mechanical Components Program

These AMPs are credited for managing the aging effects of several components in other structures and systems and are, therefore, considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Sections 3.0.3.1 and 3.0.3.7, respectively, of this SER.

After evaluating the applicant's AMR for each of the components in the hydrogen removal—post accident system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects. For those components identified in Table 3.2-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.2-2, the staff verified that the applicant credited an AMP that is appropriate for the identified aging effects.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the hydrogen removal — post accident system components will effectively manage or monitor the aging effects identified in the LRA.

Conclusions

On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.2.4.4 Reactor Building Spray System

Summary of Technical Information in the Application

The description of the reactor building spray system can be found in Section 2.3.2.4 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3-14. The components, aging effects, and AMPs are provided in LRA Tables 3.2-1 and 3.2-2.

Aging Effects:

Components of the reactor building spray system are described in LRA Section 2.3.2.4 as being within the scope of licence renewal and subject to an AMR. Table 2.3-14 of the LRA lists individual components of the system including orifices, pipe, pumps (casing only), spray nozzles, tank, tube and tube fitting, and valves (body only).

Stainless steel components are identified as being subject to loss of material due to crevice and pitting corrosion and cracking due to SCC in borated or treated water environments. No aging effects are identified for stainless steel components in reactor building, sheltered, ventilation, or yard environments.

Carbon steel components are identified as being subject to loss of material due to general corrosion in sheltered environments. Carbon steel components are identified as being subject to loss of material due to boric acid corrosion (aggressive chemical attack) in sheltered environments. Carbon steel components are identified as being subject to loss of material due to general corrosion in yard environments. Carbon steel components are identified as being subject to loss of material due to crevice, galvanic, general, and pitting corrosion in treated water environments. No aging effects are identified for carbon steel components in air-gas environments.

Aging Management Programs:

The following AMPs are utilized to manage aging effects in the reactor building spray system:

- Boric Acid Corrosion Surveillances Program
- Chemistry Program
- Above Ground Tank Inspection Program
- Inspections for Mechanical Components Program

A description of these AMPs is provided in Appendix B of the LRA. The applicant concluded that the effects of aging associated with the components of the reactor building spray system will be adequately managed by these AMPs during the period of extended operation.

Staff Evaluation

Aging Effects:

The staff reviewed the information in LRA Tables 2.3-14, 3.2-1, and 3.2-2 for the reactor building spray system. During its review, the staff determined that additional information was needed.

In RAI 3.2-3, the staff requested the applicant to provide the basis, for all potential sheltered environments in the ESF systems, that stainless steel components are not susceptible to any aging effects requiring management, as stated in LRA Table 3.2-2, Item 1. The staff's discussion of this RAI and its resolution by the applicant is provided in Section 3.2.2.4.1 of this SER.

In RAI 3.2-6, the staff requested the applicant to provide the basis for not considering loss of mechanical closure integrity an aging effect (as stated in LRA Table 3.2-1, Item 12), and to discuss the plant-specific AMR of closure bolting, in reference to the intent of GALL XI.M18, "Bolting Integrity." The staff's discussion of this RAI and its resolution by the applicant is provided in Section 3.2.2.4.1 of this SER.

The aging effects identified in the LRA for the components in the reactor building spray system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs:

The applicant credited the following AMPs for managing the aging effects in the reactor building spray system:

- Boric Acid Corrosion Surveillances Program
- Chemistry Program
- Above Ground Tank Inspection Program
- Inspections for Mechanical Components Program

These AMPs are credited for managing the aging effects of several components in other structures and systems and are, therefore, considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Sections 3.0.3.1, 3.0.3.2, 3.0.3.5, and 3.0.3.7, respectively, of this SER.

After evaluating the applicant's AMR for each of the components in the reactor building spray system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects. For those components identified in Table 3.2-1 of the

LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.2-2, the staff verified that the applicant credited an AMP that is appropriate for the identified aging effects.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the components of the reactor building spray system will effectively manage or monitor the aging effects identified in the LRA.

Conclusions

On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.2.4.5 Refueling Water System

Summary of Technical Information in the Application

The description of the refueling water system can be found in Section 2.3.2.5 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3-15. The components, aging effects, and AMPs are provided in LRA Tables 3.2-1 and 3.2-2.

Aging Effects:

Components of the refueling water system are described in LRA Section 2.3.2.5 as being within the scope of licence renewal and subject to an AMR. Table 2.3-15 of the LRA lists individual components of the system, including pipe and tanks.

Stainless steel components or components with stainless steel cladding are identified as being subject to crack initiation and growth due to SCC in a treated water environment. The stainless steel RWST (including attached piping) is identified as being subject to loss of material due to crevice and pitting corrosion and cracking due to the corrosive impacts of alternate wetting and drying in treated water environments. No aging effects are identified for stainless steel components in air-gas environments.

Aging Management Programs:

The following AMPs are utilized to manage the aging effects in the refueling water system:

- Chemistry Program
- Above Ground Tank Inspection Program

A description of these AMPs is provided in Appendix B of the LRA. The applicant states that the effects of aging associated with the components of the refueling water system will be adequately managed by these AMPs during the period of extended operation.

Staff Evaluation

Aging Effects:

The staff reviewed the information in LRA Tables 2.3-15, 3.2-1, and 3.2-2 for the refueling water system. During its review, the staff determined that additional information was needed.

In RAI 3.2-3, the staff requested the applicant to provide the basis, for all potential sheltered environments in the ESF systems, that stainless steel components are not susceptible to any aging effects requiring management, as stated in LRA Table 3.2-2, Item 1. The staff's discussion of this RAI and its resolution by the applicant is provided in Section 3.2.2.4.1 of this SER.

In RAI 3.2-6, the staff requested the applicant to provide the basis for not considering loss of mechanical closure integrity an aging effect (as stated in LRA Table 3.2-1, Item 12), and to discuss the plant-specific AMR of closure bolting, in reference to the intent of GALL XI.M18, "Bolting Integrity." The staff's discussion of this RAI and its resolution by the applicant is provided in Section 3.2.2.4.1.2 of this SER.

The aging effects identified in the LRA for the components in the refueling water system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs:

The applicant credited the following AMPs for managing the aging effects in the refueling water system:

- Chemistry Program
- Above Ground Tank Inspection Program

These AMPs are credited for managing the aging effects of several components in other structures and systems and are, therefore, considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Sections 3.0.3.2 and 3.0.3.5, respectively, of this SER.

After evaluating the applicant's AMR for each of the components in the refueling water system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects. For those components identified in Table 3.2-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.2-2, the staff verified that the applicant credited an AMP that is appropriate for the identified aging effects.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the components of the refueling water system will effectively manage or monitor the aging effects identified in the LRA.

<u>Conclusions</u>

On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.2.4.6 Residual Heat Removal System

Summary of Technical Information in the Application

The description of the residual heat removal system can be found in Section 2.3.2.6 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3-16. The components, aging effects, and AMPs are provided in LRA Tables 3.2-1 and 3.2-2.

Aging Effects:

Components of the residual heat removal system are described in LRA Section 2.3.2.6 as being within the scope of license renewal and subject to an AMR. Table 2.3-16 of the LRA lists individual components of the system including heat exchangers (channel head), heat exchangers (shell), heat exchangers (tubes), heat exchangers (tubesheet), orifices, pipe, pumps (casing only), tube and tube fitting, and valves (body only).

Stainless steel components are identified as being subject to loss of material due to crevice and pitting corrosion and cracking due to SCC in borated water environments. Stainless steel components are identified as being subject to loss of material due to crevice and pitting corrosion in treated water environments. No aging effects are identified for stainless steel components in sheltered or reactor building environments.

Carbon steel components are identified as being subject to loss of material due to general corrosion in sheltered environments. Carbon steel components are identified as being subject to loss of material due to boric acid corrosion (aggressive chemical attack) in an environment with dripping of chemically treated borated water. Carbon steel components are identified as being subject to loss of material due to crevice, galvanic, general and pitting corrosion in treated water environments.

Aging Management Programs:

The following AMPs are utilized to manage aging effects in the residual heat removal system:

- Boric Acid Corrosion Surveillances Program
- Chemistry Program
- Inspections for Mechanical Components Program

A description of these AMPs is provided in Appendix B of the LRA. The applicant states that the effects of aging associated with the components of the residual heat removal system will be adequately managed by these AMPs during the period of extended operation.

Staff Evaluation

Aging Effects:

The staff reviewed the information in LRA Tables 2.3-16, 3.2-1, and 3.2-2 for the residual heat removal system. During its review, the staff determined that additional information was needed.

In RAI 3.2-3, the staff requested the applicant to provide the basis, for all potential sheltered environments in the ESF systems, that stainless steel components are not susceptible to any aging effects requiring management, as stated in LRA Table 3.2-2, Item 1. The staff's discussion of this RAI and its resolution by the applicant is provided in Section 3.2.2.4.1 of this SER.

In LRA Table 3.2-1, Item 9, the applicant stated that, for components serviced by the closed-cycle cooling system, the Chemistry Program (LRA Appendix B.1.4) has proven effective in maintaining the system's chemistry and detecting abnormal conditions. The applicant also stated that a review of operating experience confirms the effectiveness of the Chemistry Program to manage aging effects when continued into the period of extended operation. The applicant, therefore, concluded that a verification program, such as a one-time inspection, is not warranted for the components in this component group. In RAI 3.2-5, the staff requested the applicant to justify that, under all circumstances, the Chemistry Program will be sufficient to manage the aging effects associated with the components. By letter dated June 12, 2003, the applicant stated that LRA Table 3.2-1, Item 9, includes only the residual heat removal (RHR) heat exchanger and the RHR pump seal cooler. Both of these components have reactor coolant cooled by the component cooling system. The applicant stated that review of the VCSNS operating experience reviews have not found a reason to require a one time inspection of these stainless steel RHR components in a borated water (RCS) environment. In addition, the applicant stated that the treated water environment of these components contains corrosion inhibitors whose function is to form a passivated layer that prohibits corrosion from forming. The applicant stated, therefore, that it is not necessary to schedule one-time inspections for the RHR heat exchangers and RHR seal coolers. The staff finds that applicant's response adequately justifies the effectiveness of the Chemistry Program. This determination is based on the successful operating experience of these RHR components, the GALL guidance that the effects of pitting and crevice corrosion on stainless steel components are not significant in chemically treated borated water (GALL Section VII.E1), and the use of corrosion inhibitors which prohibits the occurrence of corrosion on these RHR components.

In RAI 3.2-6, the staff requested the applicant to provide the basis for not considering loss of mechanical closure integrity an aging effect (as stated in LRA Table 3.2-1, Item 12), and to discuss the plant-specific AMR of closure bolting, in reference to the intent of GALL XI.M18, "Bolting Integrity." The staff's discussion of this RAI and its resolution by the applicant is provided in Section 3.2.2.4.1 of this SER.

The aging effects identified in the LRA for the components in the residual heat removal system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs:

The applicant credited the following AMPs for managing the aging effects in the residual heat removal system:

- Boric Acid Corrosion Surveillances Program
- Chemistry Program
- Inspections for Mechanical Components Program

These AMPs are credited for managing the aging effects of several components in other structures and systems and are, therefore, considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Sections 3.0.3.1, 3.0.3.2, and 3.0.3.7, respectively, of this SER.

After evaluating the applicant's AMR for each of the components in the residual heat removal system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects. For those components identified in Table 3.2-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.2-2, the staff verified that the applicant credited an AMP that is appropriate for the identified aging effects.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the components of the residual heat removal system will effectively manage or monitor the aging effects identified in the LRA.

Conclusions

On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.2.4.7 Safety Injection System

Summary of Technical Information in the Application

The description of the safety injection system can be found in Section 2.3.2.7 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3-17. The components, aging effects, and AMPs are provided in LRA Tables 3.2-1 and 3.2-2.

Aging Effects:

Components of the safety injection system are described in LRA Section 2.3.2.7 as being within the scope of license renewal and subject to an AMR. Table 2.3-17 of the LRA lists individual components of the system including orifices, pipe, tanks, tube and tube fittings, and valves (body only).

Stainless steel components are identified as being subject to crevice and pitting corrosion and SCC in borated water environments. No aging effects are identified for stainless steel

components in reactor building, sheltered, air-gas, or demineralized/deaerated water (i.e., treated water with absence of oxygen) environments.

Carbon steel components are identified as being subject to loss of material due to general corrosion in sheltered or reactor building environments. Carbon steel components are identified as being subject to loss of material due to boric acid corrosion (aggressive chemical attack) in sheltered or reactor building environments. No aging effects are identified for carbon steel components in air-gas (dry) environments.

Aging Management Programs:

The following AMPs are utilized to manage aging effects in the safety injection system:

- Boric Acid Corrosion Surveillances Program
- Chemistry Program
- Inspections for Mechanical Components Program

A description of these AMPs is provided in Appendix B of the LRA. The applicant concluded that the effects of aging associated with the components of the safety injection system will be adequately managed by these AMPs during the period of extended operation.

<u>Staff Evaluation</u>

Aging Effects:

The staff reviewed the information in LRA Tables 2.3-17, 3.2-1, and 3.2-2 for the safety injection system. During its review, the staff determined that additional information was needed.

In RAI 3.2-3, the staff requested the applicant to provide the basis, for all potential sheltered environments in the ESF systems, that stainless steel components are not susceptible to any aging effects requiring management, as stated in LRA Table 3.2-2, Item 1. The staff's discussion of this RAI and its resolution by the applicant is provided in Section 3.2.2.4.1 of this SER.

In RAI 3.2-6, the staff requested the applicant to provide the basis for not considering loss of mechanical closure integrity an aging effect (as stated in LRA Table 3.2-1, Item 12), and to discuss the plant-specific AMR of closure bolting, in reference to the intent of GALL XI.M18, "Bolting Integrity." The staff's discussion of this RAI and its resolution by the applicant is provided in Section 3.2.2.4.1 of this SER.

The aging effects identified in the LRA for the components in the safety injection system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs:

The applicant credited the following AMPs for managing the aging effects in the safety injection system:

- Boric Acid Corrosion Surveillances Program
- Chemistry Program
- Inspections for Mechanical Components Program

These AMPs are credited for managing the aging effects of several components in other structures and systems and are, therefore, considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Sections 3.0.3.1, 3.0.3.2, and 3.0.3.7, respectively, of this SER.

After evaluating the applicant's AMR for each of the components in the safety injection system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects. For those components identified in Table 3.2-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.2-2, the staff verified that the applicant credited an AMP that is appropriate for the identified aging effects.

On the basis of its review, the staff finds that AMPs credited in the LRA for the components of the safety injection system will effectively manage or monitor the aging effects identified in the LRA.

Conclusions

On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3 Aging Management of Auxiliary Systems

This section addresses the aging management of the components of the auxiliary systems group. The systems that make up the auxiliary systems group are described in the following SER Sections:

- air handling and local ventilation and cooling systems (2.3.3.1)
- boron recycle system (2.3.3.2)
- building services (2.3.3.3)
- chilled water system (2.3.3.4)
- circulating water system (2.3.3.5)
- component cooling water system (2.3.3.6)
- diesel generator services system (2.3.3.7)
- fire service system (2.3.3.8)
- fuel handling system (2.3.3.9)
- gaseous waste processing system (2.3.3.10)
- industrial cooler system (2.3.3.11)

- instrument air supply system (2.3.3.12)
- leak detection system (2.3.3.13)
- liquid waste processing system (2.3.3.14)
- nuclear and non-nuclear plant drains (2.3.3.15)
- nuclear sampling system (2.3.3.16)
- radiation monitoring system (2.3.3.17)
- reactor makeup water supply system (2.3.3.18)
- roof drains system (2.3.3.19)
- station service air system (2.3.3.20)
- service water system (2.3.3.21)
- spent fuel cooling system (2.3.3.22)
- thermal regeneration system (2.3.3.23)

As discussed in Section 3.0.1 of this SER, the components in each of these auxiliary systems are included in one of two LRA tables. LRA Table 3.3-1 consists of the auxiliary system components that are evaluated in the GALL Report and relied on for license renewal, and LRA Table 3.3-2 consists of the auxiliary system components that are different from, or not addressed in, the GALL Report and that are relied on for license renewal.

3.3.1 Summary of Technical Information in the Application

In LRA Section 3.3, the applicant described its AMRs for the auxiliary systems group at VCSNS.

The description of the systems that comprise the auxiliary systems group can be found in LRA Section 3.3.

The passive, long-lived components in these systems that are subject to an AMR are identified in LRA Tables 2.3.-18 through 2.3.-37.

The applicant's AMRs included an evaluation of plant-specific and industry operating experience. The plant-specific evaluation included reviews of condition reports and to discussions with appropriate site personnel to identify aging effects that require management. These reviews concluded that the aging effects requiring management based on the VCSNS operating experience were consistent with aging effects identified in GALL.

The applicant's review of industry operating experience included a review of operating experience through 2001. The results of this review concluded that aging effects requiring management based on industry operating experience were consistent with aging effects identified in GALL.

The applicant's ongoing review of plant-specific and industry-wide operating experience is conducted in accordance with the VCSNS Operating Experience Program.

3.3.2 Staff Evaluation

In Section 3.3 of the LRA, the applicant described its AMR for the auxiliary systems at VCSNS. The staff reviewed LRA Section 3.3 to determine whether the applicant provided sufficient information to demonstrate that the effects of aging will be adequately managed so that the

intended functions will be maintained consistent with the CLB throughout the period of extended operation, in accordance with the requirements of 10 CFR 54.21(a)(3), for the auxiliary system components that are determined to be within the scope of license renewal and subject to an AMR.

The applicant referenced the GALL Report in its AMR. The staff has previously evaluated the adequacy of the aging management of auxiliary system components for license renewal as documented in the GALL Report. Thus, the staff did not repeat its review of the matters described in the GALL Report, except to ensure that the material presented in the LRA was applicable, and to verify that the applicant had identified the appropriate programs as described and evaluated in the GALL Report. The staff evaluated those aging management issues recommended for further evaluation in the GALL Report. The staff also reviewed aging management information submitted by the applicant that was different from that in the GALL Report or was not addressed in the GALL Report. Finally, the staff reviewed the FSAR supplement to ensure that it provided an adequate description of the programs credited with managing aging for the auxiliary system components.

In LRA Section 3.3, the applicant provided brief descriptions of the auxiliary systems and summarized the results of its AMR of the auxiliary systems at VCSNS.

Table 3.3-1 below provides a summary of the staff's evaluation of components, aging effects/mechanisms, and AMPs listed in LRA Section 3.3 that are addressed in the GALL Report.

Table 3.3-1: Staff Evaluation Table for VCSNS Auxiliary System Components Evaluated in the GALL Report				
Component Group	**Aging Effect/Mechanism**	**AMP in GALL Report**	**AMP in LRA**	**Staff Evaluation**
Components in spent fuel pool cooling and cleanup	Loss of material due to general, pitting, and crevice corrosion	Water Chemistry and One-Time Inspection	Chemistry Program	Consistent with GALL. GALL recommends further evaluation. (See Section 3.3.2.2.1 below.)
Linings in spent fuel pool cooling and cleanup system; seals and collars in ventilation systems	Hardening; cracking and loss of strength due to elastomer degradation; loss of material due to wear	Plant specific	Inspections for Mechanical Components Program	Consistent with GALL. GALL recommends further evaluation. (See Section 3.3.2.2.2 below.)
Components in load handling, chemical and volume control system (PWR), and reactor water cleanup and shutdown cooling systems (older BWR)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Time-Limiting Aging Analysis	GALL recommends further evaluation. (See Section 3.3.2.2.3 below.)
Heat exchangers in reactor water cleanup system (BWR); high pressure pumps in chemical and volume control system (PWR)	Crack initiation and growth to SCC or cracking	Plant-specific	Chemistry Program	These components are scoped under ESF system. (See Section 3.3.2.2.4 below.)
Components in ventilation systems, diesel fuel oil system, and emergency diesel generator systems; external surfaces of carbon steel components	Loss of material due to general, pitting, and crevice corrosion and MIC	Plant-specific	Maintenance Rule Structures Program, Preventive Maintenance Activities—Ventilation Systems Inspections, Diesel Generator Systems Inspection, Inspections for Mechanical Components Program	Consistent with GALL. GALL recommends further evaluation. (See Section 3.3.2.2.5 below.)
Components in reactor coolant pump oil collection system of fire protection	Loss of material due to galvanic, general, pitting, and crevice corrosion	Fire Protection	One-Time Inspection	Consistent with GALL. (See Section 3.3.2.4.8 below)
Diesel fuel oil tanks in diesel fuel oil system and emergency diesel generator system	Loss of material due to general, pitting, and crevice corrosion, MIC, and biofouling	Fuel Oil Chemistry	Chemistry Program	Exceptions taken to GALL on performing one-time inspections to verify the effectiveness of the Chemistry Program under the CLB.
Piping, pump casing, and valve body and bonnets in shutdown cooling system (older BWR)	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	N/A	BWR

Table 3.3-1: Staff Evaluation Table for VCSNS Auxiliary System Components Evaluated in the GALL Report				
Component Group	**Aging Effect/Mechanism**	**AMP in GALL Report**	**AMP in LRA**	**Staff Evaluation**
Heat exchangers in chemical and volume control system	Crack initiation and growth due to SCC and cyclic loading	Water Chemistry and a plant-specific verification program	Chemistry Program	These components are scoped under ESF system. (See Section 3.3.2.2.8 below.)
Neutron absorbing sheets in spent fuel storage racks	Reduction of neutron absorbing capacity and loss of material due to general corrosion (Boral, boron steel)	Plant-specific	N/A	These components are scoped under structures and are addressed in Section 3.5.2.4.2 of this SER.
New fuel rack assembly	Loss of material due to general, pitting, and crevice corrosion	Structures Monitoring	N/A	The applicant has determined that the new fuel rack assembly at VCSNS does not perform an intended function and is not within scope of license renewal.
Spent fuel storage racks and valves in spent fuel pool cooling and cleanup	Crack initiation and growth due to stress corrosion cracking	Water Chemistry	Chemistry Program	Consistent with GALL (See Section 3.3.2.1 below)
Neutron absorbing sheets in spent fuel storage racks	Reduction of neutron absorbing capacity due to Boraflex degradation	Boraflex Monitoring	N/A	These components are scoped under structures and are addressed in Section 3.5.2.4.2 of this SER.
Closure bolting and external surfaces of carbon steel and low-alloy steel components	Loss of material due to boric acid	Boric Acid Corrosion	Boric Acid Corrosion Surveillances Program	Consistent with GALL. (See Section 3.3.2.1 below.)
Components in or serviced by closed-cycle cooling water system	Loss of material due to general, pitting, and MIC	Closed-Cycle Cooling Water System	Chemistry Program	Consistent with GALL. (See Section 3.3.2.1 below.)
Cranes, including bridge and trolleys and rail system, in load handling systems	Loss of material due to general corrosion and wear	Inspection of Overhead Heavy Load and Light Load Handling systems	Materials Handling System Inspection Program; Maintenance Rule Structures Program	These components are scoped under structures and are addressed in Sections 3.5.2.4.1 and 3.5.2.4.2 of this SER.
Components in or serviced by open-cycle cooling water systems	Loss of material due to general, pitting, crevice, and galvanic corrosion, MIC, and biofouling; build up of deposit due to biofouling	Open-Cycle Cooling Water System	Service Water System Reliability and In-service Testing Program	Consistent with GALL. (See Section 3.3.2.1 below.)

Table 3.3-1: Staff Evaluation Table for VCSNS Auxiliary System Components Evaluated in the GALL Report				
Component Group	**Aging Effect/Mechanism**	**AMP in GALL Report**	**AMP in LRA**	**Staff Evaluation**
Buried piping and fittings	Loss of material due to general, pitting, and crevice corrosion and MIC	Buried Piping and Tanks Surveillance or Buried Piping and Tanks Inspection	Buried Piping and Tanks Inspection Program	Consistent with GALL. (See Section 3.3.2.1 below.) GALL recommends further evaluation
Components in compressed air system	Loss of material due to general and pitting corrosion	Compressed Air Monitoring	Service Air System Inspection	Consistent with GALL. (See Section 3.3.2.1 below.)
Components (doors and barrier penetration seals) and concrete structures in fire protection	Loss of material due to wear; hardening and shrinkage due to weathering	Fire Protection	Fire Protection Program	Exceptions taken to GALL on fire door inspections at a frequency of every 6 months under the CLB, rather than the bi-monthly frequency recommended in GALL. Concrete structures and penetration seals consistent with GALL. (See Section 3.0.3.3)
Components in water-based fire protection	Loss of material due to general, pitting, crevice, and galvanic corrosion, MIC, and biofouling	Fire Water System	Fire Protection Program	Consistent with GALL/ISG. (See Section 3.0.3.3 below.)
Components in diesel fire system	Loss of material due to galvanic, general, pitting, and crevice corrosion	Fire Protection and Fuel Oil Chemistry	Fire Protection Program	Components/component type AMR results for diesel fuel oil of the fire service system is included with the diesel fuel oil supply portions in separate section of Table 3.3-1 of the LRA. As such, NUREG-1801 items within this group are not considered applicable to VCSNS. The component/component type AMR of diesel driven fire pump are included in the appropriate portion of Table 3.3-1 of the LRA.

Table 3.3-1: Staff Evaluation Table for VCSNS Auxiliary System Components Evaluated in the GALL Report				
Component Group	**Aging Effect/Mechanism**	**AMP in GALL Report**	**AMP in LRA**	**Staff Evaluation**
Tanks in diesel fuel oil system	Loss of material due to general, pitting, and crevice corrosion	Above Ground Carbon Steel Tanks	N/A	The applicant indicated that the corresponding fuel oil storage tanks at VCSNS are located underground.
Closure bolting	Loss of material due to general corrosion; crack initiation and growth due to cyclic loading and SCC	Bolting Integrity	N/A	The applicant has determined that non-Class 1 closure bolting is considered to be a piece-part of the components/ component types as a whole at VCSNS. Therefore, a bolting integrity program is not credited for aging management.
Components in contact with sodium pentaborate solution in standby liquid control system (BWR)	Crack initiation and growth due to SCC	Water Chemistry	N/A	BWR
Components in reactor water cleanup system	Crack initiation and growth due to SCC and IGSCC	Reactor Water Cleanup System Inspection	N/A	BWR
Components in shutdown cooling system (older BWR)	Crack initiation and growth due to SCC	BWR Stress Corrosion Cracking and Water Chemistry	N/A	BWR
Components in shutdown cooling system (older BWR)	Loss of material due to pitting and crevice corrosion and MIC	Closed-Cycle Cooling Water System	N/A	BWR
Components (aluminum bronze, brass, cast iron, cast steel) in open-cycle and closed-cycle cooling water systems and ultimate heat sink	Loss of material due to selective leaching	Selective Leaching of Materials	Heat Exchanger Inspections Program	Consistent with GALL. (See Section 3.3.2.1 below.)
Fire barriers, walls, ceilings, and floors in fire protection	Concrete cracking and spalling due to freeze-thaw, aggressive chemical attack, and reaction with aggregates; loss of material due to corrosion of embedded steel	Fire Protection and Structures Monitoring	Fire Protection	Consistent with GALL. (See Section 3.0.3.3 below.)

The staff's review of the auxiliary systems for the VCSNS LRA is contained within four sections of this SER. Section 3.3.2.1 is the staff review of components in the auxiliary systems that the applicant has indicated are consistent with GALL and do not require further evaluation. Section 3.3.2.2 is the staff review of components in the auxiliary systems that the applicant has indicated are consistent with GALL and for which GALL recommends further evaluation.

Section 3.3.2.3 is the staff evaluation of AMPs that are specific to the auxiliary systems group. Section 3.3.2.4 contains an evaluation of the adequacy of aging management for components in each system in the auxiliary systems group and includes an evaluation of components in the auxiliary systems that the applicant indicates are not in GALL.

3.3.2.1 Aging Management Evaluations in the GALL Report That Are Relied On for License Renewal, That Do Not Require Further Evaluation

For component groups evaluated in GALL for which the applicant has claimed consistency with GALL, and for which GALL does not recommend further evaluation, the staff sampled components in these groups to determine whether the plant-specific components contained in these GALL component groups were bounded by the GALL evaluation. The staff also sampled component groups to determine whether the applicant had properly identified those component groups in GALL that were not applicable to its plant. For the AMRs of those component groups (in LRA Table 3.3-1) which the applicant claimed to be at least partially consistent with GALL, and for which no further evaluations are recommended, the staff evaluated the applicant's conformance with the aging management recommended by GALL for the auxiliary systems. Review results of the evaluation, for which additional information is further required from the applicant, are discussed in Sections 3.3.2.4 and 3.3.2.5 of this SER, these sections document the staff's review of the applicant's AMR for specific components within the auxiliary systems.

On the basis of its review of the inspection results, the staff has verified the applicant's claim of consistency with GALL report. The staff finds that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.2 Aging Management Evaluations in the GALL Report That Are Relied On for License Renewal, For Which GALL Recommends Further Evaluation

For component groups evaluated in GALL for which the applicant has claimed consistency with GALL, and for which GALL recommends further evaluation, the staff reviewed the applicant's evaluation to determine whether it adequately addressed the issues for which GALL recommended further evaluation. In addition, the staff sampled components in these groups to determine whether the plant-specific components contained in these GALL component groups were bounded by the GALL evaluation.

The GALL Report indicates that further evaluation should be performed for the aging effects discussed in the following sections.

3.3.2.2.1 Loss of Material Due to General, Pitting, and Crevice Corrosion

Loss of material due to general, pitting, and crevice corrosion could occur in the channel head and access cover, tubes, and tubesheets of the heat exchanger in the spent fuel pool cooling and cleanup system, while loss of material due to pitting and crevice corrosion could occur in the filter housing, valve bodies, and nozzles of the ion exchanger in the spent fuel pool cooling and cleanup system. The Water Chemistry Program relies on monitoring and control of reactor water chemistry based on EPRI guidelines TR-105714 for primary water chemistry in PWRs, and TR-102134 for secondary water chemistry in PWRs, to manage the effects of loss of

material from general, pitting, or crevice corrosion. However, high concentrations of impurities at crevices and locations of stagnant flow conditions could cause general, pitting, or crevice corrosion. Therefore, verification of the effectiveness of the Chemistry Control Program should be performed to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to manage loss of material from general, pitting, and crevice corrosion to verify the effectiveness of the Water Chemistry Program. A one-time inspection of select components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the components intended function will be maintained during the period of extended operation.

The staff reviewed the applicant's proposed program to ensure that corrosion is not occurring and that the component intended functions will be maintained during the period of extended operation. If the applicant proposed a one-time inspection of select components at susceptible locations to ensure that corrosion is not occurring, the staff verified that the applicant's selection of susceptible locations is based on severity of conditions, time of service, and lowest design margin. The staff also verified that the proposed inspection would be performed using techniques similar to ASME Code and ASTM standards, including visual, ultrasonic, and surface techniques.

For components listed in the "SF" system of the VCSNS Database AMR Query Table, the applicant credited the Chemistry Program (B.1.4) for managing loss of material due to crevice, galvanic, general, and pitting corrosion of the carbon steel heat exchanger shell component in the spent fuel cooling system exposed to treated water environment. Control of water chemistry may not preclude corrosion at locations of stagnant flows or crevices. It may be necessary to perform one-time inspection at susceptible locations for verification of the effectiveness of the Chemistry program. By letter dated March 28, 2003, the staff requested, in RAI B.1.4-1, the applicant to address the concern pertaining to the effectiveness of the Chemistry Program. The staff's evaluation of this issue is documented in Section 3.0.3.2 of this SER.

On the basis of its review, the staff finds that the applicant has appropriately evaluated AMR results involving management of the loss of material due to general, pitting, and crevice corrosion, as recommended in the GALL Report. Since the applicant's AMR results are other wise consistent with the GALL report, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.2.2 Hardening and Cracking or Loss of Strength Due to Elastomer Degradation or Loss of Material Due to Wear

The GALL Report recommends further evaluation of programs to manage the hardening and cracking due to elastomer degradation of valves in the spent fuel pool cooling and cleanup system. The GALL Report also recommends further evaluation of programs to manage the hardening and loss of strength due to elastomer degradation of the collars and seals of the duct and of the elastomer seals of the filters in the control room area, auxiliary and radwaste area, and primary containment heating and ventilation system, as well as the collars and seals of the duct in the diesel generator building ventilation system. The GALL Report also recommends further evaluation of programs to manage the loss of material due to wear of the collars and

seals of the ducts in the ventilation systems. The staff reviewed the applicant's proposed programs to ensure that an adequate program will be in place for the management of these aging effects.

The applicant did not identify any elastomer component in the spent fuel cooling system at VCSNS. In the VCSNS LRA (Table 3.3-1), elastomer-based components in air or gas (indoor) are associated with the aging effects of hardening, cracking, and loss of strength due to elastomer degradation. The applicant has identified the AMP B.2.11, Inspections for Mechanical Components Program, to manage these aging effects. This AMP is evaluated in Section 3.0.3.7 of this SER. The staff finds that the Inspection for Mechanical Components Program can effectively manage the aging effects of elastomers for the above components that are applicable to VCSNS. The applicant also adequately addressed the aging effect of loss of material due to wear in its response to RAI 3.3.2.4.7-1 in Section 3.3.2.4.7 of this SER.

On the basis of its review, the staff finds that the applicant has appropriately evaluated AMR results involving management of hardening and cracking or loss of strength due to elastomer degradation or loss of material due to wear, as recommended in the GALL Report. Since the applicant's AMR results are other wise consistent with the GALL report, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.2.3 Cumulative Fatigue Damage

Fatigue is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). The staff reviewed the evaluation of this TLAA in Section 4.3 of this SER, following the guidance in Section 4.3 of the SRP-LR.

3.3.2.2.4 Crack Initiation and Growth Due to Cracking or Stress-Corrosion Cracking

The GALL Report recommends further evaluation of programs to manage crack initiation and growth due to cracking of the high pressure pump in the chemical and volume control system (CVCS). The staff reviewed the applicant's proposed program to ensure that an adequate program will be in place for the management of this aging effect.

In the VCSNS LRA, the CVCS is scoped under ESF systems. The staff's evaluation of the ESF systems is documented in Section 3.2.2.4.1 of this SER.

3.3.2.2.5 Loss of Material Due to General, Microbiologically Influenced, Pitting, and Crevice Corrosion

The GALL Report recommends further evaluation of programs to manage the loss of material due to general, pitting, and crevice corrosion of (1) the piping and filter housing and supports in the control room area, the auxiliary and radwaste area, and the primary containment heating and ventilation systems, (2) the piping of the diesel generator building ventilation system, and (3) the aboveground piping and fittings, valves, and pumps in the diesel fuel oil system and the diesel engine starting air, combustion air intake, and combustion air exhaust subsystems in the emergency diesel generator system. The GALL Report also recommends further evaluation of programs to manage the loss of material due to general, pitting, and crevice corrosion and MIC

of the duct fittings, access doors, closure bolts, equipment frames, and housing of the duct due to (1) pitting and crevice corrosion of the heating/cooling coils of the air handler heating/cooling, and (2) general corrosion of the external surfaces of all carbon steel SCs, including bolting exposed to operating temperatures less than 212 °F in the ventilation systems. The staff reviewed the applicant's proposed program to ensure that an adequate program will be in place for the management of these aging effects.

For components in this component/commodity group, the plant specific Inspections for Mechanical Components AMP is used to detect and manage the applicable aging effects, including loss of material due to general and pitting corrosion and cracking on external surfaces of mechanical components. The Maintenance Rule Structures Program is used to detect and manage MIC caused by ground water intrusion at penetrations below elevation 425 ft. The Preventive Maintenance Activities—Ventilation Systems Inspections AMP is a plant- specific condition monitoring program that will in part detect and manage loss of material due to general corrosion for ventilation system components exposed to a ventilation environment. The Diesel Generator Systems Inspection AMP is used to detect and manage internal general corrosion in susceptible components exposed to moist air and exhaust, such as expansion joints, piping, and tanks. The applicant stated that the Diesel Generator Systems Inspection AMP, B.2.2, will be enhanced to include the mufflers and exhaust piping.

The Inspections for Mechanical Components AMP, the Maintenance Rule Structures Program, the Preventive Maintenance Activities—Ventilation Systems Inspections AMP, and the Diesel Generator Inspection AMP are evaluated in Sections 3.0.3.7, 3.3.0.4, 3.3.2.3.3, and 3.3.3.2.3.4 of this SER, respectively. The staff finds that these programs can effectively manage the aging effects for external and internal surfaces of the applicable components for the auxiliary systems.

On the basis of its review, the staff finds that the applicant has appropriately evaluated AMR results involving management of the loss of material due to general, pitting, and crevice corrosion, as recommended in the GALL Report. Since the applicant's AMR results are other wise consistent with the GALL report, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.2.6 Loss of Material Due to General, Galvanic, Pitting, and Crevice Corrosion

The GALL Report recommends further evaluation of programs to manage the loss of material due to general, galvanic, pitting, and crevice corrosion of tanks, piping, valve bodies, and tubing in the RCP oil collection system in fire protection systems. The Fire Protection Program relies on a combination of visual and volumetric examinations in accordance with the guidelines of 10 CFR Part 50, Appendix R and Branch Technical Position 9.5-1 to manage loss of material from corrosion. However, corrosion may occur at locations where water from wash downs may accumulate. Therefore, verification of the effectiveness of the program should be performed to ensure that degradation is not occurring and that the component's intended function will be maintained during the period of extended operation. The staff reviewed the applicant's proposed program to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation (B.1.5 - Fire Protection Program-Mechanical, GALL AMP XI.M.27) (see staff audit report dated October 9, 2003).

On the basis of its review, the staff finds that the applicant has appropriately evaluated AMR results involving management of the loss of material due to general, galvanic, pitting, and crevice corrosion, as recommended in the GALL Report. Since the applicant's AMR results are other wise consistent with the GALL report, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.2.7 Loss of Material Due to General, Pitting, Crevice, and Microbiologically Influenced Corrosion and Biofouling

The GALL Report recommends further evaluation of programs to manage loss of material due to general, pitting, and crevice corrosion and MIC and due to biofouling of the internal surface of tanks in the diesel fuel oil system, as well as general, pitting, crevice, and MIC of the tanks of the diesel engine fuel oil system in the emergency diesel generator system. The Fuel Oil Chemistry Program relies on monitoring and control of fuel oil contamination, in accordance with the guidelines of ASTM Standards D4057, D1796, D2709, and D2276, to manage loss of material due to corrosion or biofouling. Corrosion or biofouling may occur at locations where contaminants accumulate. Verification of the effectiveness of the Fuel Oil Chemistry Program should be performed to ensure that corrosion/biofouling is not occurring and that the component's intended function will be maintained during the period of extended operation.

The staff reviewed the applicant's proposed program to ensure that corrosion/biofouling is not occurring and that the component intended function will be maintained during the period of extended operation. If the applicant proposed a one-time inspection of select components at susceptible locations to ensure that corrosion/biofouling is not occurring, the staff verified that the applicant's selection of susceptible locations is based on severity of conditions, time of service, and lowest design margin. The staff also verified that the proposed inspection would be performed using techniques similar to ASME Code and ASTM standards, including visual, ultrasonic, and surface techniques.

In GALL, carbon steel components in fuel oil, and water (as contaminant) are associated with the aging effect of loss of material from general, pitting, crevice corrosion, MIC, and biofouling. The relevant AMPs include GALL XI.M30, "Fuel Oil Chemistry," and GALL XI.M32, "One-Time Inspection." In the VCSNS LRA (Table 3.3-1), carbon steel components in a fuel oil environment are associated with the aging effect of loss of material from general, pitting, crevice corrosion MIC, and galvanic corrosion. The applicant credited the Chemistry Program, AMP B1.4, to manage these aging effects. For the components of the diesel generator services system, the applicant also credited the Chemistry Program to manage the aging effects. The Chemistry Program is consistent with GALL XI.M30, a "Fuel Oil Chemistry" AMP, but does not include a one-time inspection. It should be noted that the GALL Report recommends further evaluation for detection of aging effects and a one-time inspection program for verifying the effectiveness of fuel oil chemistry control. By letter dated March 28, 2003, the staff requested, in RAI B.1.4-1, the applicant to address the concern pertaining to the effectiveness of the Chemistry Program. The staff's evaluation of this issue is documented in Section 3.0.3.2 of this SER.

On the basis of its review, the staff finds that the applicant has appropriately evaluated AMR results involving management of the loss of material due to general, pitting, crevice, MIC, and

biofouling, as recommended in the GALL Report. Since the applicant's AMR results are otherwise consistent with the GALL report, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.2.8 Crack Initiation and Growth Due to Stress-Corrosion Cracking and Cyclic Loading

Crack initiation and growth due to SCC and cyclic loading could occur in the channel head and access cover, tubesheet, tubes, shell and access cover, and closure bolting of the regenerative heat exchanger, as well as in the channel head and access cover, tubesheet, and tubes of the letdown heat exchanger in the CVCS. The Water Chemistry Program relies on monitoring and control of water chemistry, based on the guidelines of TR-105714 for primary water chemistry to manage the effects of crack initiation and growth due to SCC and cyclic loading. The GALL Report recommends further evaluation to manage crack initiation and growth from SCC and cyclic loading for this system to verify the effectiveness of the Water Chemistry Program. The staff reviewed the applicant's proposed program to ensure that cracking is not occurring and that the component intended function will be maintained during the period of extended operation. A one-time inspection of select components at susceptible locations is an acceptable method to ensure that crack initiation and growth are not occurring and that the component intended functions will be maintained during the period of extended operation. If the applicant proposed a one-time inspection of select components at susceptible locations to ensure that corrosion is not occurring, the staff verified that the applicant's selection of susceptible locations is based on severity of conditions, time of service, and lowest design margin. The staff also verified that the proposed inspection would be performed using techniques similar to ASME Code and ASTM standards, including visual, ultrasonic, and surface techniques.

In the VCSNS LRA, the CVCS is scoped under the ESF systems. The staff's evaluation of the ESF systems is documented in Section 3.2.2.4.1 of this SER.

On the basis of its review, the staff finds that the applicant appropriately evaluated AMR results involving management of crack initiation and growth due to stress-corrosion cracking and cyclic loading, as recommended in the GALL report. Since the applicant's AMR results are otherwise consistent with the GALL report, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.2.9 Reduction of Neutron-Absorbing Capacity and Loss of Material Due to General Corrosion

Reduction of neutron-absorbing capacity and loss of material due to general corrosion could occur in the neutron-absorbing sheets of the spent fuel storage rack. The GALL Report recommends further evaluation of programs to manage these aging effects. The staff reviewed the applicant's proposed program to ensure that an adequate program will be in place for the management of these aging effects.

In the VCSNS LRA, the spent fuel storage rack is scoped under structures. The staff's evaluation of the structures is documented in Section 3.5.2.4.2.2 of this SER.

On the basis of its review, the staff finds that the applicant appropriately evaluated AMR results involving management of reduction of neutron-absorbing capacity and loss of material due to general corrosion, as recommended in the GALL report. Since the applicant's AMR results are other wise consistent with the GALL report, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.2.10 Loss of Material Due to General, Pitting, Crevice, and Microbiologically Influenced Corrosion

Loss of material due to general, pitting, and crevice corrosion and MIC could occur in the underground piping and fittings in the open-cycle cooling water system (service water system) and in the diesel fuel oil system. The Buried Piping and Tanks Inspection Program relies on industry practice, frequency of pipe excavation, and operating experience to manage the effects of loss of material from general, pitting, and crevice corrosion and MIC. The staff reviewed the effectiveness of the Buried Piping and Tanks Inspection Program, including its inspection frequency and operating experience, to ensure that loss of material is not occurring and that the component intended function will be maintained during the period of extended operation.

The applicant credited the Buried Piping and Tanks Inspection AMP, B.2.10, to manage the above aging effects that are applicable to the auxiliary systems. By letter dated March 28, 2003, the staff requested, in RAI B.2.10-1, the applicant to address the concern pertaining to the adequacy of the Buried Piping and Tanks Inspection Program. The staff's evaluation of this issue is documented in Section 3.0.3.2 of this SER.

On the basis of its review, the staff finds that the applicant appropriately evaluated AMR results involving management of loss of material due to general, pitting, crevice, and microbiologically influenced corrosion, as recommended in the GALL report. Since the applicant's AMR results are other wise consistent with the GALL report, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3 Aging Management Programs for Auxiliary Systems Components

In SER Sections 3.3.2.1 and 3.3.2.2, the staff determined that the applicant's AMRs and associated AMPs, will adequately manage component aging in the auxiliary systems. The staff then reviewed specific components in the auxiliary systems to ensure that they were properly evaluated in the applicant's AMR.

To perform its evaluation, the staff reviewed the components listed in LRA Sections 2.3.3.1 through 2.3.3.23 and Tables 2.3-18, through 2.3-37 as well as in the tables entitled, "Virgil C. Summer Nuclear Station Database AMR Query" and "Virgil C. Summer Nuclear Station Database AMR Query Notes in the supplement to determine whether the applicant had properly identified the applicable AMRs and AMPs needed to adequately manage the aging effects for the components. This portion of the staff review involved identification of the aging effects for each component, ensuring that each aging effect was evaluated using the appropriate AMR in

Section 3, and that management of the aging effect was captured in the appropriate AMP. The results of the staff's review are provided below.

The staff also reviewed the FSAR supplement for the AMPs credited with managing aging in reactor system components to determine whether the program description adequately describes the program.

The applicant credits 16 AMPs to manage the aging effects associated with components in the auxiliary systems. Eight of the AMPs are credited to manage aging for components in other system groups (common AMPs) while eight AMPs are credited to manage aging only for auxiliary system components. The staff's evaluation of the common AMPs credited with managing aging in auxiliary system components is provided in Section 3.0.3 of this SER. The common AMPs include the following:

- Boric Acid Corrosion Surveillances Program (3.0.3.1)
- Chemistry Program (3.0.3.2)
- Fire Protection Program (3.0.3.3)
- Maintenance Rule Structures Programs (3.0.3.4)
- Above Ground Tank Inspection Program (3.0.3.5)
- Buried Piping and Tanks Inspection Program (3.0.3.6)
- Inspections for Mechanical Components Programs (3.0.3.7)
- Heat Exchanger Inspections Program (3.0.3.8)

The staff's evaluation of the eight auxiliary systems AMPs are provided here:

3.3.2.3.1 Service Water System Reliability and In-Service Testing Program

Summary of Technical Information in the Application

The applicant's Service Water System Reliability and In-Service Testing Program is discussed in LRA Section B.1.9, "Service Water System Reliability and Inservice Testing." The applicant stated that the program is consistent with GALL AMP XI.M20, "Open-Cycle Cooling Water System," with no exceptions or enhancements specified in the LRA. The LRA credits this in-service testing program with managing the effects of aging for components in raw water environments at VCSNS. In Section B.1.9 and FSAR supplement 18.2.33 of the LRA, the applicant described the Service Water System Reliability and In-Service Testing Program as an existing AMP that manages cracking, fouling, and loss of material for susceptible materials located in systems containing raw water from the service water pond. More specifically, the Service Water System Reliability and In-Service Testing Program is credited with managing the following aging effects during the period of extended operation:

- loss of material due to general, pitting, and crevice corrosion and MIC

- particulate fouling and loss of material due to erosion of susceptible components or component types

- fouling due to biological materials

The applicant credited its Service Water System Reliability and In-Service Testing Program for managing cracking, fouling, and loss of material in the air handling and local ventilation and cooling systems, chilled water system component cooling water system, diesel generator services system, and service water system.

The applicant stated in the LRA Operating Experience, Section B.1.9.1, “the application of measured corrosion rates had been demonstrated to supply adequate information on the rate of loss of material to predict when replacement of components might be necessary.” The applicant further stated that, based on operating experience, the performance testing on raw water heat exchangers furnishes adequate predictive modeling for fouling of heat transfer surfaces to prevent loss of intended function. The applicant also stated that its Service Water System Reliability and In-Service Testing Program is capable of detecting pinhole leaks in the service water system prior to loss of function. The applicant confirmed that periodic visual inspections of the service water system piping are conducted to monitor the extent of cracking, fouling, and loss of material. The heat transfer capabilities of heat exchangers serviced by the service water system are also evaluated to detect the presence of fouling.

Applicant letter RC.02.0159 dated September 12, 2002 submitted a revised description of the B.1.9 AMP to include non-nuclear safety related components that were not initially included in the scope of the license renewal, but that meet the refined 10 CFR 54.4 (a)(2) criteria.

In Section B.1.9 of the LRA, the applicant concluded that the Service Water System Reliability and In-Service Testing Program has been demonstrated to be capable of managing the effects of aging for components in raw water environments. The applicant also concluded that the Service Water System Reliability and In-Service Testing Program provides reasonable assurance that the aging effect will be managed such that the components subject to AMR will continue to perform their intended functions consistent with the CLB for the extended period of operation.

In Attachment 1 to letter dated September 12, 2002, the applicant stated that a reevaluation of each attribute of the service water system reliability, and In-Service testing program confirms that the program, as described, provides reasonable assurance that loss of material will be managed during the period of extended operation.

Staff Evaluation

In LRA Section B.1.9, “Service Water System Reliability and In-Service Testing,” the applicant described its program to managing the effects of aging for components in raw water environments within the scope of license renewal. The LRA states that this program is consistent with GALL AMP XI.M20, “Open-Cycle Cooling Water System.” The staff confirmed the applicant’s claim of consistency during the license renewal AMP audit. The staff reviewed the summary description of the program in the FSAR supplement (Section 18.2.33 of Appendix A to the LRA).

The staff identified that the applicant mentioned the requirements of NRC GL 89-13, “Service Water System Problems Affecting Safety-Related Equipment,” in discussing the related closed-cycle cooling water system (LRA Table 3.3-3, AMR Item 14) and the Underwater Inspection Program (LRA Section B.1.23). Although the applicant made no mention of either GL 89-13 or its Supplement 1 with reference to the service water system, it has stated in LRA

Section B.1.9 that the AMP is consistent with GALL AMP XI.M20, “Open-Cycle Cooling Water System,” which uses GL 89-13 as a major reference. Thus, the staff understands that the applicant is following all of the specific requirements of these generic letters for this system with respect to the following:

- surveillance and control of biofouling
- test program to verify heat transfer capabilities
- routine inspection and maintenance program to ensure that corrosion, erosion, protective coating failure, silting, and biofouling cannot degrade the performance of safety-related systems served by this system
- system walkdown inspection to ensure compliance with the licensing basis
- review of maintenance, operating, and training practices and procedures

The staff reviewed the LRA Criteria 2 Supplement to determine whether the applicant has demonstrated that the Service Water System Reliability and In-Service Testing Program will adequately manage the applicable aging effects for the components that credit the program throughout the period of continued operation, as required by 10 CFR 54.21(a)(3). The staff finds that the applicant has demonstrated that there is reasonable assurance that the credited program will ensure that loss of material in non-nuclear safety related components in the service water system will be detected and corrected for the period of extended operation.

Section 18.2.33 of Appendix A to the LRA contains the applicant’s FSAR supplement for the Service Water System Reliability and In-Service Testing Program at VCSNS. The staff reviewed the FSAR supplement and found that the description of the service water system reliability and in-service testing program is consistent with Section B.1.9 of the LRA. The staff finds that the information contained in the FSAR supplement presents an adequate summary of the program activities, as required by 10 CFR 54.21(d).

Conclusions

On the basis of its review and audit of the applicant’s program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.3.2.3.2 Material Handling System Inspection Program

Summary of Technical Information in the Application

The applicant’s Material Handling System Inspection Program is discussed in LRA Section B.1.19, “Material Handling System Inspection Program.” The applicant stated that the program

is consistent with GALL XI.M23, “Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems,” for the bridge and trolley structural members and rails with the following clarifications related to the Scope and the Parameters Monitored and Inspected program elements.

[Scope] The polar crane girders and brackets are addressed under the Maintenance Rule Structures Program and wear on the crane rails has been determined not to require aging management for the VCSNS cranes.

[Parameters Monitored and Inspected] The number and magnitude of lifts made by the cranes are addressed as a TLAA under Section 4.7.2 of the VCSNS LRA.

The LRA credits this program with managing loss of material for crane rails, rail supports, and structural supports at VCSNS. In Section B.1.19 of Appendix B to the LRA, the applicant claimed that the Material Handling System Inspection Program has been demonstrated to be capable of managing loss of material for crane rails, rail supports, and structural supports. The applicant further stated that the Material Handling System Inspection Program has been in effect for many years at VCSNS and includes nuclear safety-related and quality-related (seismically restrained) material handling system components. Material handling systems steel support structures (rails, runways, monorails, girders, jib cranes, seismic restraints, and associated connections) are inspected in accordance with the guidance provided by the ANSI standards. The applicant stated that inspections are implemented in the course of routine maintenance (FSAR Supplement 18.2.23).

The applicant stated that industry’s operating experience for the material handling system was reviewed in association with the Maintenance Rule. The applicant stated that through monitoring the effectiveness of maintenance at nuclear power plants, there has been no corrosion-related degradation that has impaired the cranes.

In Section B.1.19 of the LRA, the applicant concluded that the Material Handling System Inspection Program has been demonstrated to be capable of managing loss of material for crane rails, rail supports, and structural supports. The Material Handling System Inspection Program provides reasonable assurance that the aging effects will be managed such that the components subject to AMR will continue to perform their intended functions consistent with the CLB.

<u>Staff Evaluation</u>

In LRA Section B.1.19, “Material Handling System Inspection Program,” the applicant described its AMP to manage aging of the material handing system. The LRA stated that this AMP is consistent with the GALL AMP XI.M23, “Inspection of Overhead Heavy Loads and Light Loads (Related to Refueling) Handling Systems,” for the bridge and trolley structural members and rails with the following clarifications related to the Scope and the Parameters Monitored and Inspected program elements. The staff confirmed the applicant’s claim of consistency during the license renewal audit conducted on July 16-17, 2003.

[Scope] The polar crane girders and brackets are addressed under the Maintenance Rule Structures Program and wear on the crane rails has been determined not to require aging management for the VCSNS cranes.

[Parameters Monitored and Inspected] The number and magnitude of lifts made by the cranes are addressed as a TLAA under Section 4.7.2 of the VCSNS LRA.

The inclusion of the information discussed above causes changes in some attributes of the GALL AMP XI.M23, "Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems." Therefore, the staff reviewed this AMP against only those attributes of the applicant's program which deviate from the attributes of the GALL program, using the guidance in BTP RLSB-1 in Appendix A of the SRP-LR. The staff also reviewed the FSAR supplement to determine whether it provides an adequate description of the program.

Under scope, the AMP identifies a clarification that the polar crane girders and brackets are managed under the Maintenance Rule Structures Program. Only components in the auxiliary systems are managed by this AMP. The applicant stated (LRA Table 3.3-1, AMR Item 15) that loss of material in steel rails and girders will be managed by the Material Handling System Inspection Program, while the Maintenance Rule Structures Program (LRA, Appendix B.1.18) is responsible for managing the aging of structures and structural components. The applicant stated that these aging effects, including loss of material due to corrosion, cracking, and change in material properties, are detected by visual inspection of external surfaces (LRA, Table 3.3-1, AMR Item 15). Also under scope, the AMP identifies a clarification related to wear on the crane rails; wear on the crane rails has been determined not to require aging management for the VCSNS cranes. The applicant further states in AMR Item 15 that wear is movement of a material in relation to another material in contact with the first; wear can occur during the performance of active functions. The applicant stated that according to the License Renewal Rule [10 CFR 54.21(a)(1)(i)], SCs subject to an AMR must perform their intended functions without moving parts or without a change in configuration or properties. The applicant concluded that, as such, loss of material due to wear is not an aging effect requiring further evaluation for license renewal, and is only considered a consequence of frequent or rough usage.

As described in the GALL Report Item VII.B.2-a and AMP XI.M23, loss of material due to wear on crane rails falls within the scope of license renewal, because the crane rails are passive, long-lived components and loss of material due to wear caused by active components is an applicable aging effect. By letter dated March 28, 2003, the staff requested, in RAI B.1.19-1, that the applicant justify its conclusion that loss of material due to wear does not require aging management for VCSNS cranes. In its response dated June 12, 2003, the applicant stated that LRA AMP B.1.19 identified that wear on crane rails has been determined not to require aging management for VCSNS cranes, referencing TR00170-003 (Section 6.9) which asserts that wear of crane rails due to rolling or sliding wheels is not expected in any measurable amount, due to infrequent crane use. The applicant further stated that although "wear" is not considered an applicable aging mechanism at VCSNS, the Material Handling System Inspection Program is capable of detecting loss of material on crane rails from corrosion and/or wear. Accordingly, the applicant stated that plant procedures do include inspection of rails for "abnormal wear" as part of the AMP.

The staff noted that TR00170-003 (Section 6.9, "Summary of Aging Effect Evaluations Different From Those Described in the GALL Report") only claimed that "wear of crane rails due to rolling or sliding wheels is not expected in any measurable amount due to the infrequent crane use. Review of past inspection reports at VCSNS indicates that those cranes within the license renewal scope are in good working condition." Considering the reported age-related failure to a

bridge guide roller bearing, the staff is concerned that wear on crane rails is possible and should be considered an aging effect. During a telecommunication on July 14, 2003 the applicant explained that the bearing failure was in an active component and that structural components are not in the scope of this program. The applicant agreed that inspection for wear was included in plant procedures and that it would be managed. By letter dated September 2, 2003, the applicant stated that VCSNS plant procedures currently require inspection of crane rails for abnormal wear and that such procedures would remain in effect for the period of extended operation. This response also identified that the frequency of these inspections is every 18 months and/or prior to use. Considering that wear of the crane rails will be effectively managed for the period of extended operation, the staff finds that the applicant's response satisfactorily addresses the staff's concerns and RAI B.1.19-1 is considered closed.

The staff noted that the LRA is not clear which cranes are covered by this AMP. The only reference to this AMP is in AMR Table 3.3-1, Item 15; however, there are no LRA Section 2 tables that refer to this AMR item. By letter dated March 28, 2003, the staff requested, in RAI B.1.19-2, that the applicant clarify which cranes use the Material Handling System Inspection Program. In its response dated June 12, 2003, the applicant stated that a detailed discussion of the Material Handling System Inspection Program AMR is contained in TR00170-003, Section 7.13, including identification of all VCSNS cranes that are within the license renewal scope. The staff noted, following review of the document, that TR00170-003 (Section 7.13, "Material Handling System Inspection Program"), cited above by the applicant, comprehensively describes the AMR of the cranes and clarifies which cranes use the Material Handling System Inspection Program. Therefore, the staff considers the applicant's response to be acceptable and RAI B.1.19-2 is considered closed.

The applicant identified a clarification concerning parameters monitored and inspected. The number of lifts made by the cranes is addressed as a TLAA under Section 4.7.2 of the application. The staff identified that the correct reference should be to Section 4.7.3, which is addressed under Section 4.7.5 of the SER.

Section 18.2.23 of Appendix A to the LRA contains the applicant's FSAR supplement for the Material Handling System Inspection Program at VCSNS. The staff reviewed the FSAR supplement and found that the description of the Material Handling System Inspection Program is consistent with Section B.1.19 of the LRA. The staff finds that the information contained in the FSAR supplement presents an adequate summary of the program activities as required by 10 CFR 54.21(d).

Conclusions

On the basis of its review and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.3.2.3.3 Preventive Maintenance Activities—Ventilation Systems Inspections

Summary of Technical Information in the Application

The applicant's Preventive Maintenance Activities—Ventilation Systems Inspections Program is discussed in LRA Section B.1.26, "Preventive Maintenance Activities—Ventilation Systems Inspections Program." The LRA credits this preventive inspections program with managing loss of material and fouling in susceptible components in the air handling, local ventilation, and component cooling systems at VCSNS that are exposed internally to moist air.

The applicant claimed that the Preventive Maintenance Activities—Ventilation Systems Inspections Program is a plant-specific condition monitoring program that will manage the following:

- loss of material due to boric acid corrosion, galvanic corrosion, and general corrosion in carbon steel, galvanized steel, and copper components

- fouling due to particulates in aluminum, copper, and copper-nickel heat exchanger components

Components in the air handling, local ventilation, and components cooling systems for the following structures and areas are monitored by this AMP—control building, auxiliary and radwaste area, fuel handling building, turbine building, engineering safety features, intermediate building, miscellaneous building, and reactor building. The applicant verifies (FSAR Supplement 18.2.25) that routine maintenance inspections are conducted which include detection of age-related degradation.

In Section B.1.26 of the LRA, the applicant concluded that the Preventive Maintenance Activities—Ventilation Systems Inspections Program has been demonstrated to be capable of detecting and managing the effects of aging for components exposed to a ventilation environment. The Preventive Maintenance Activities—Ventilation Systems Inspections Program provides reasonable assurance that the aging effects will be managed such that the components subject to AMR will continue to perform their intended functions consistent with the CLB during the period of extended operation.

Staff Evaluation

In LRA Section B.1.26, "Preventive Maintenance Activities—Ventilation Systems Inspections Program," the applicant described its AMP to manage loss of material and fouling in susceptible components in the air handling, local ventilation, and component cooling systems at VCSNS that are exposed internally to moist air. The LRA states that this is a new, plant-specific AMP; therefore, the staff reviewed the program using the guidance in BTP RLSB-1 in Appendix A of the SRP-LR. The staff's evaluation focused on management of aging effects through incorporation of the following 10 elements from RLSB-1—program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience. The applicant indicated that the corrective actions, confirmation process, and administrative controls for license renewal are in accordance with the site-controlled Quality Assurance Program. The staff's evaluation of the applicant's Quality Assurance Program is provided separately in Section 3.0.4 of this SER; the evaluation of the remaining seven

elements is provided below. The staff also reviewed the FSAR supplement to determine whether it provides an adequate description of the program.

[Program Scope] The applicant stated that this AMP is applicable to specified systems and components exposed to a ventilation environment. The staff finds that the systems and components monitored by the Preventive Maintenance Activities—Ventilation Systems Inspections Program, as listed in Section B.1.26 of the LRA, are within the scope of license renewal as identified in Section 2.3 of the LRA. The staff identified that crevice corrosion and MIC are not addressed in this AMP. SRP-LR Section 3.3.2.2.5 identifies crevice corrosion and MIC as aging mechanisms for ductwork and other components in ventilation systems. The resolution of the concern related to MIC in ductwork is addressed in the response to RAI B.2.11-1 and in Section 3.3.2.2.5 of this SER. The scope is acceptable to the staff because it includes those components that rely on the program for aging management.

[Preventive Actions] The applicant stated that no actions are taken as part of this program to prevent the aging effects or to mitigate aging degradation. The staff did not identify the need for preventive actions in this AMP because it is a condition monitoring program.

[Parameters Monitored or Inspected] The applicant stated that this program inspects exposed components for visible evidence of corrosion that indicate possible loss of material, and accumulation of dust and particulates on fins and tubes that indicate possible fouling. The staff finds the above visible inspection parameters acceptable because they are directly related to the degradation of carbon steel components and the fouling of heat exchanger components. Visual inspections are effective in detecting such conditions.

[Detection of Aging Effects] The applicant stated that the program will detect the presence and extent of the aging effects (loss of material due to boric acid corrosion, galvanic corrosion, and general corrosion and fouling due to particulates in the ventilation system) prior to a loss of component intended function. The staff finds that these inspection techniques are sufficient to provide reasonable assurance that the aging effects for the components addressed by the Preventive Maintenance Activities—Ventilation Systems Inspections Program will be detected before the loss of intended function.

[Monitoring and Trending] The applicant stated “routine periodic visual inspections are conducted…in order to detect age-related degradation and to initiate corrective actions as necessary.” By letter dated March 28, 2003, the staff requested, in RAI B.1.26-1, the applicant to specify the frequency of these periodic inspections and how the inspection frequency is determined. In its response dated June 12, 2003, the applicant stated that the Preventive Maintenance Activities—Ventilation Systems Inspections Program is the license renewal name for the diverse preventive maintenance activity already being routinely performed on components that can be credited for managing aging during the period of extended operation. The applicant further stated that the preventive maintenance performed on the component cooling water pump motor cooling coils is conducted on 10-year intervals. The applicant also stated that the preventive maintenance performed on the fan coils for air-handling units is conducted on semiannual intervals. Preventive maintenance on the reactor building cooling units (RBCUs) is conducted at intervals less than 5 years. The staff is concerned that inspection intervals must be established to detect degradation prior to loss of the component function, and inspections performed at intervals greater than 5 years are not consistent with GL 89-13. During a telecommunication with the applicant on July 14, 2003, the staff requested further

information to establish how the inspection frequency is determined. By letter dated September 2, 2003, the applicant identified that the preventive maintenance frequency for the component cooling water pump motor cooling coils and air-handling units is based on vendor recommendations. This response also clarified that the inspection of the RBCUs is in addition to the performance testing required by Generic Letter 89-13 that is performed under the Service Water System Reliability and In-Service Testing Program. The staff finds that the applicant's response satisfactorily addresses the staff's concerns and RAI B.1.26-1 is considered closed.

The applicant stated that for the RBCUs, an engineering procedure requires recording of temperature monitoring data annually, or at least once per refueling cycle. Although temperatures are trended for the RBCUs, Element 3, Parameters Monitored or Inspected and Element 4, Detection of Aging Effects, discuss visual inspections and do not mention temperature monitoring. By letter dated March 28, 2003, the staff requested, in RAI B.1.26-2, the applicant to clarify how the temperature measurements are used in this program. In its response dated June 12, 2003, the applicant stated that the preventive maintenance performed on the RBCUs includes visually inspecting inlet and outlet coil faces as a step in performance testing. The applicant further stated that performance testing involves trending temperatures for the RBCUs. The response did not address how the trended temperatures are used, how the information from visual inspections is used, and how inaccessible areas are inspected. During a telecommunication with the applicant on July 14, 2003, the staff requested written information to address this concern. By letter dated September 2, 2003, the applicant clarified that temperature monitoring of the RBCUs is not performed under this program, but is performed as a step in the performance testing of service water heat exchangers which is a commitment to GL 89-13 performed under the Service Water System Reliability and In-Service Testing Program. This response also identified that the preventive maintenance program performed on the RBCUs includes visually inspecting coil exteriors and drain pans for cleanliness and signs of degradation and corrosion. In this letter, the applicant further states that, because the ventilation air would encounter the outermost tubes before encountering the innermost tubes, it is expected that the outermost tubes of the bundle would experience as much or more contaminants than the innermost tubes. The staff finds that the applicant's response satisfactorily addresses the staff's concerns and RAI B.1.26-2 is considered closed.

[Acceptance Criteria] The applicant stated that the acceptance criterion is no unacceptable loss of material or fouling of subject components that could result in a loss of the component intended functions as determined by engineering evaluation. The applicant stated that engineering procedure contains specific acceptance criteria for the RBCUs. The staff finds that these acceptance criteria are adequate to ensure that the component intended functions are maintained under all CLB design conditions during the period of extended operation.

[Operating Experience] The applicant verified that a review of work histories for the past 10 years revealed that no age-related degradation had been detected for the subject components. The staff finds that the applicant's operating experience indicates that the Preventive Maintenance Activities—Ventilation Systems Inspections Program has effectively maintained the integrity of the components and the effects of aging will be adequately managed during the period of extended operation.

Section 18.2.25 of Appendix A to the LRA contains the applicant's FSAR supplement for the Preventive Maintenance Activities—Ventilation Systems Inspections Program at VCSNS. The staff reviewed the FSAR supplement and found that the description of the Preventive

Maintenance Activities—Ventilation Systems Inspections Program is consistent with Section B.1.26 of the LRA. The staff finds that the information contained in the FSAR supplement presents an adequate summary of the program activities, as required by 10 CFR 54.21(d).

Conclusions

On the basis of its review of the applicant's program, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.3.2.3.4 Diesel Generator Systems Inspection Program

Summary of Technical Information in the Application

The applicant's Diesel Generator Systems Inspection Program is discussed in LRA Section B.2.2, "Diesel Generator Systems Inspection." The applicant stated that this is a new program and therefore summarized the program in terms of the 10-element program described in BTP Appendix A-1 of the SRP-LR. The LRA credits this inspection at VCSNS with managing loss of material in diesel generator components due to general corrosion and/or the corrosive impacts of alternate wetting and drying in air-gas environments. The applicant stated that this new one-time inspection will detect and characterize loss of material due to general corrosion and the corrosive impacts of alternate wetting and drying in air-gas environments. The Diesel Generator Systems Inspection Program will determine if aging management is required for certain carbon steel diesel generator support system components during the period of extended operation. This inspection will use suitable examination techniques at the most susceptible (sample) locations (FSAR Supplement 18.2.13). The applicant stated that the Diesel Generator Systems Inspection Program will be consistent with GALL AMP XI.M32, "One-Time Inspection," and that the one-time inspection will be performed prior to the period of extended operation.

In Section B.2.2 of the LRA, the applicant concluded that implementation of the Diesel Generator Systems Inspection Program will either verify that there are no aging effects requiring management for the subject components, or ensure that appropriate corrective actions will be taken so that the component intended functions will be maintained during the period of extended operations.

Staff Evaluation

The staff reviewed the information in Section B.2.2 of Appendix B to the LRA, the applicant's response to the staff's RAI, and the summary descriptions of the program in the FSAR supplement (Section 18.2.13 of Appendix A to the LRA). Since the applicant claimed consistency with GALL AMP XI.M32, this AMP was cross-referenced in the staff's review. The 10 program elements in this GALL AMP for one-time inspection supply detailed programmatic characteristics and criteria that the staff considers necessary to verify the absence of aging effects and the effectiveness of the AMP. Therefore, the staff reviewed the program using the guidance in BTP RLSB-1 in Appendix A of the SRP-LR. The staff's evaluation focused on managing aging effects through incorporation of the following 10 elements from RLSB-1—

program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience. The applicant indicated that the corrective actions, confirmation process, and administrative controls for license renewal are in accordance with the site-controlled Quality Assurance Program. The staff's evaluation of the applicant's Quality Assurance Program is provided separately in Section 3.0.4 of this SER; and the evaluation of the remaining seven elements is provided below. The staff also reviewed the FSAR supplement to determine whether it provides an adequate description of the program.

[Program Scope] The applicant stated that this AMP is applicable to the following components in the diesel generator services system—carbon steel expansion joints normally exposed to moist air which are exposed to exhaust air during engine operation, and carbon steel tanks and associated tubing components exposed to starting and control air. These components of concern are exposed to air-gas internal environments. The staff finds that the SCs monitored by the Diesel Generator Systems Inspection Program, as listed in Section B.2.2 of the LRA, are within the scope of license renewal, as identified in Section 2.3 of the LRA. The scope is acceptable to the staff because it includes those components that rely on the program for aging management.

By letter dated March 28, 2003, the staff requested, in RAI B.2.2-1, further information about the program scope. Since the plant operating experience should supply information on degradation due to loss of material caused by general corrosion and alternate wetting and drying, the staff asked the applicant to clarify the operating experience and identify any experience of degraded system conditions within the program scope. In its response dated June 12, 2003, the applicant stated that operating experience, both site-specific and industry-wide, was researched to identify the possible aging effects for various material environment combinations; the resulting information is retained at VCSNS. The applicant confirmed that operating experience at VCSNS for the components managed by this program revealed no history of degradation for the internal surfaces, and that this one-time inspection was developed because it was determined that the aging effects were possible, and not because they were found at VCSNS. In a telecommunication with the applicant on July 14, 2003, the staff requested confirmation from the applicant, based on the response to RAI 3.3.2.4.7-3, that the scope of this program will be revised to include mufflers and exhaust piping. By letter dated September 2, 2003, the applicant identified that the inspections of carbon steel components exposed to exhaust gases will include exhaust expansion joints, exhaust piping, associated exhaust tubing, and mufflers. By letter dated September 2, 2003, the applicant provided a revised FSAR supplement to revise the summary of Section 18.2.13, to include exhaust air components. The staff finds that the applicant's response satisfactorily addresses the staff's concerns and RAI B.2.2-1 is considered closed.

[Preventive Actions] The applicant stated that no actions are taken as part of this program to prevent the aging effects or to mitigate aging degradation. The staff did not identify the need for preventive actions in this AMP.

[Parameters Monitored or Inspected] The applicant stated that the parameters inspected as part of this AMP include wall thickness and/or visible evidence of corrosion, including pitting and discoloration, to indicate possible loss of material for the carbon steel components. The staff finds these parameters acceptable because they are directly related to the degradation of carbon steel components in the diesel generator systems.

[Detection of Aging Effects] The applicant stated that the AMP will use a combination of proven volumetric and/or visual examination techniques on a sample population of the subject components to be determined by engineering evaluation. A sample of carbon steel components most susceptible to aging effects from alternate wetting and drying in a moist air and exhaust air environment (such as expansion joints, the starting air tanks, mufflers and exhaust piping) have been selected as representative for such testing. The applicant further stated that results of the inspection will be applied to the remainder of the components within the scope of the inspection activity. The AMP will detect the presence and extent of any loss of material due to general corrosion and the corrosive impacts of alternative wetting and drying for the subject components prior to loss of their intended functions.

The staff finds that these inspection techniques are sufficient to provide reasonable assurance that the aging effect for the components addressed by the Diesel Generator Systems Inspection Program will be detected before a component has lost its intended function. The use of one-time inspection is appropriate for inspections where degradation is possible, but is not expected on the basis of plant-specific and industry operating experience. This one-time inspection provides for additional inspections should the corrective action process require additional information to characterize the aging effects.

[Monitoring and Trending] The applicant stated that no actions are taken as a part of the Diesel Generator Systems Inspection Program to trend inspection results. This is a one-time program used to determine if further actions are required. The staff did not identify the need for monitoring and trending for this AMP.

[Acceptance Criteria] The applicant stated that the acceptance criterion is no unacceptable loss of material of the subject components that could result in a loss of the component intended functions, as determined by engineering evaluation. The staff considers this engineering evaluation to be adequate to assure that the intended functions for components in the Diesel Generator Systems Inspection Programs are maintained under all CLB design conditions during the period of extended operation.

[Operating Experience] The applicant stated that the Diesel Generator Systems Inspection Program is a new one-time inspection for which there is no operating experience. By letter dated March 28, 2003, the staff requested, in RAI B.2.2-1, to identify any experience of degraded system conditions within the program scope based on the plant operating experience on degradation due to loss of material caused by general corrosion and alternate wetting and drying. In its response dated June 12, 2003, the applicant stated that operating experience, both site-specific and industry-wide, was researched to identify the possible aging effects for various material/environment combinations; the resulting information is retained at VCSNS. The applicant confirmed that operating experience at VCSNS, for the components managed by this program, revealed no history of degradation for the internal surfaces, and that this one-time inspection was developed because it was determined that the aging effects were possible, and not because they were found at VCSNS. The staff finds that the applicant's operating experience indicates that the effects of aging will be adequately managed during the period of extended operation.

Section 18.2.13 of Appendix A to the LRA contains the applicant's FSAR supplement for the Diesel Generator Systems Inspection Program at VCSNS. The staff reviewed the FSAR supplement and found that the description of the Diesel Generator Systems Inspection Program

is consistent with Section B.2.2 of the LRA. The staff finds that the information contained in the FSAR supplement presents an adequate summary of the program activities, as required by 10 CFR 54.21(d).

Conclusions

On the basis of its review and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.3.2.3.5 Liquid Waste System Inspection Program

Summary of Technical Information in the Application

The applicant's Liquid Waste System Inspection Program is discussed in LRA Section B.2.3, "Liquid Waste System Inspection." The applicant stated that this is a new program and therefore summarized the program in terms of the 10-element program described in BTP Appendix A-1 of the SRP-LR. The LRA credits this inspection with detecting and characterizing loss of material due to crevice and pitting corrosion and cracking due to SCC in unmonitored and uncontrolled borated water environments at VCSNS. The applicant stated that this new one-time inspection will detect and characterize loss of material due to crevice and pitting corrosion and cracking due to SCC in systems and components exposed to unmonitored and uncontrolled borated water environments. This one-time inspection activity will determine if aging management is required for certain stainless steel pipe, valves, and heat exchanger components during the period of extended operation. The Liquid Waste System Inspection Program will use a combination of volumetric and visual examination techniques at the most susceptible (sample) locations (FSAR Supplement 18.2.21). The applicant stated that this inspection will be consistent with GALL AMP XI.M32, "One-Time Inspection."

In Section B.2.3 of the LRA, the applicant concluded that implementation of the Liquid Waste System Inspection Program will either verify that there are no aging effects requiring management for the subject components, or ensure that appropriate corrective actions will be taken so that the component intended functions will be maintained during the period of extended operations.

Staff Evaluation

In LRA Section B.2.3, "Liquid Waste System Inspection," the applicant described its AMP to manage loss of material due to crevice and pitting corrosion and cracking due to SCC in unmonitored and uncontrolled borated water environments. Since the applicant claimed consistency with GALL AMP XI.M32, this AMP was cross-referenced in the staff's review. The 10 program elements in this GALL AMP for one-time inspection supply detailed programmatic characteristics and criteria that the staff considers necessary to provide additional assurance that either aging is not occurring, or the evidence of aging is so insignificant that an AMP is not

warranted. The Liquid Waste System Inspection is a one-time inspection program with commitments to followup actions based on engineering evaluation of inspection results.

The staff reviewed the program using the guidance in BTP RLSB-1 in Appendix A of the SRP-LR. The staff's evaluation focused on management of aging effects through incorporation of the following 10 elements from RLSB-1—program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience. The applicant indicated that the corrective actions, confirmation process, and administrative controls for license renewal are in accordance with the site-controlled Quality Assurance Program. The staff's evaluation of the applicant's Quality Assurance Program is provided separately in Section 3.0.4 of this SER, and the evaluation of the remaining seven elements is provided below. The staff also reviewed the FSAR supplement to determine whether it provides an adequate description of the program.

[Program Scope] The applicant stated in the LRA that this AMP is applicable to stainless steel components exposed to unmonitored and uncontrolled borated water in nuclear plant drains (ND) and liquid waste processing (WL) systems. Applicant letter RC-02-0159 dated September 12, 2003 submitted a supplement to include components which meet 10 CFR 54.4(a)(2). Table 1, item 3 of this submittal added systems LD, LW, MD, NB, WD and WX to the scope managed by the liquid waste system inspection. Applicant letter dated September 24, 2003 submitted a new scope for AMP B.2.3 wich includes these additional systems. In this letter the applicant stated that no revision is required for the FSAR summary description provided in the LRA Section 18.2.21. The staff finds that the systems and components monitored by the Liquid Waste System Inspection Program, as listed in letter dated September 12, 2002, are within the scope of license renewal as identified in Section 2.3 of the LRA and supplemented by letter dated September 24, 2003. The scope is acceptable to the staff because it includes those components that rely on the program for aging management.

[Preventive Actions] The applicant stated that no actions are taken as part of this program to prevent the aging effects or to mitigate aging degradation. The staff did not identify the need for preventive actions in this AMP.

[Parameters Monitored or Inspected] The applicant stated that the parameters inspected as part of this AMP include wall thickness as a measure of loss of material and visual evidence of loss of material, material, cracking or other age-related degradation. The staff finds the above parameters acceptable because they are directly related to the degradation of stainless steel components exposed to an unmonitored and uncontrolled borated water environment in the aforementioned systems.

[Detection of Aging Effects] The applicant stated that the AMP will use a combination of proven volumetric and visual examination techniques on a sample population of the subject components to be determined by engineering evaluation. The applicant further states that results of the inspection will be applied to the remainder of the components within the scope of the inspection activity. The sample population will consist of susceptible locations within the boundaries of either of the two affected containment penetrations, as well as the internal tube surfaces of the affected heat exchangers.

The staff finds that these inspection techniques are sufficient to provide reasonable assurance that the aging effects for the components will be detected before a loss of intended function. The use of a one-time inspection is appropriate for inspections where degradation is possible, but is not expected on the basis of plant-specific and industry operating experience. This one-time inspection provides for additional inspections should the corrective action process require additional information to characterize the aging effects.

[Monitoring and Trending] The applicant stated that no actions are taken as a part of the Liquid Waste System Inspection Program to trend inspection results. This is a one-time program used to determine if further actions are required. The staff did not identify the need for monitoring and trending in this AMP.

[Acceptance Criteria] The applicant stated that the acceptance criterion is no unacceptable loss of material or cracking of the subject components that could result in a loss of the component intended functions, as determined by engineering evaluation. The staff considers this engineering evaluation to be adequate to assure that the intended functions for components in the Liquid Waste System Inspection Program are maintained under all CLB design conditions during the period of extended operation.

[Operating Experience] The applicant stated that the Liquid Waste System Inspection Program is a new one-time inspection for which there is no operating experience. By letter dated March 28, 2003, the staff expressed concern, in RAI B.2.3-1, about the adequacy of the AMP because (1) the components are exposed to unmonitored and uncontrolled borated water, (2) the system is used frequently, (3) this is a new program with no operating experience, (4) there is a potential for high concentrations of impurities in the water, and (5) the condition of the system is unknown. The staff asked the applicant to justify the use of a one-time inspection for the liquid waste system components. In its response dated June 12, 2003, the applicant stated that operating experience, both site-specific and industry-wide, was researched to identify the possible aging effects for various material environment combinations; the resulting information is retained at VCSNS. The applicant verified that operating experience at VCSNS for the components managed by this program revealed no history of degradation for the internal surfaces. The applicant stated that this one-time inspection was developed because it was determined that the aging effects were possible, and not because they were found at VCSNS. Since the applicant verified its analysis of relevant site-specific and industry-wide operating experience showing no relevant problems, the applicant's response satisfactorily addresses the staff's concerns and RAI B.2.3-1 is considered closed. By letter dated March 28, 2003, the staff stated, in RAI B.2.3-2, that plant operating experience with this system should reflect any age-related degradation and requested the applicant to clarify the operating experience with this system. The staff asked the applicant to present operating history on the occurrence of crevice, pitting, and stress corrosion cracking in the ND system and the WL system to justify the use of a one-time inspection for the liquid waste system components. In its response dated June 12, 2003, the applicant stated that site-specific and industry-wide operating experience was researched to identify the possible aging effects for various material and environment combinations and elaborated on management of the stainless steel components in the ND and WL systems.

> The SS ND System components managed by the Liquid Waste System Inspection function as pressure boundary for a containment penetration, used for the transfer of water out of the reactor building sump and the incore instrumentation sump. These sumps contain leakage only from high purity systems located inside the

> reactor building; components are leak tested under 10CFR50 Appendix J. Operating experience at VCSNS for the ND components managed by this program reveals no history of degradation for the internal surfaces.
>
> The SS WL System components managed by the Liquid Waste System Inspection function as pressure boundary for a containment penetration or as pressure boundary with the component cooling (CC) system. The WL components that function as pressure boundary for containment isolation are leak tested under 10CFR50 Appendix J. The contents of the reactor coolant drain tank (RCDT) are transferred through this containment penetration. Because of the purity of the systems that are the sources of the water to the RCDT, the water in the RCDT is recyclable reactor grade water. Operating experience at VCSNS for these WL components managed by this program reveals no history of degradation for the internal surfaces. The WL components that function as pressure boundary for the CC system are the tubes for the RCDT heat exchanger and the tubes for the waste evaporator (WE, which is seldom used at VCSNS) concentrates sample cooler. Operating experience at VCSNS for these WL components managed by this program reveals no history of degradation for the internal surfaces.

Since the applicant verified in its response that the operating history at VCSNS reveals no history of degradation for internal surfaces of either the ND or the WL systems, the applicant satisfactorily addressed the staff's concerns and RAI B.2.3-2 is considered closed.

Applicant letter dated September 24, 2003 stated that supplement added components are not required to maintain the pressure boundary integrity to meet their license renewal intended function. This is acceptable to the staff on the basis that the intended license renewal function to satisfy 10 CFR 54.4(a)(2) is limited to maintaining structural integrity.

Section 18.2.21 of Appendix A to the LRA contains the applicant's FSAR supplement for the Liquid Waste System Inspection Program at VCSNS. The staff reviewed the FSAR supplement and found that the description of the Liquid Waste System Inspection Program is consistent with Section B.2.3 of the LRA. The staff finds that the information contained in the FSAR supplement presents an adequate summary of the program activities as required by 10 CFR 54.21(d).

Conclusions

On the basis of its review and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.3.2.3.6 Reactor Building Cooling Unit Inspection Program

Summary of Technical Information in the Application

The applicant's Reactor Building Cooling Unit Inspection Program is discussed in LRA Section B.2.5, "Reactor Building Cooling Unit Inspection." The applicant stated that this is a new program and therefore summarized the program in terms of the 10-element program as described in BTP Appendix A-1 of the SRP-LR. The LRA credits this inspection with detecting and characterizing loss of material due to crevice and pitting corrosion and cracking due to SCC

at VCSNS resulting from exposure to an unmonitored and uncontrolled borated water environment. The applicant stated that this one-time inspection will detect and characterize loss of material due to crevice and pitting corrosion and cracking due to SCC resulting from exposure to an unmonitored and uncontrolled borated water environment. The borated water environment results from condensation out of the reactor building atmosphere, onto the RBCU cooling coils, and then into the associated drain lines. The Reactor Building Cooling Unit Inspection Program will use volumetric and/or visual examination techniques at the most susceptible (sample) locations in the RBCU drain lines (FSAR Supplement 18.2.26). The applicant stated that the Reactor Building Cooling Unit Inspection Program will be consistent with AMP XI.M32, “One-Time Inspection”, in the GALL Report. The applicant also states that this one-time inspection will be performed prior to the period of extended operation.

In Section B.2.5 of the LRA, the applicant concluded that implementation of the Reactor Building Cooling Unit Inspection Program will either verify that there are no aging effects requiring management for the subject components or appropriate corrective actions will be taken so that the component intended functions will be ensured during the period of extended operations.

Staff Evaluation

In LRA Section B.2.5, “Reactor Building Cooling Unit Inspection,” the applicant described its AMP to manage loss of material due to crevice and pitting corrosion and cracking due to SCC at VCSNS resulting from exposure to an unmonitored and uncontrolled borated water environment. Since the applicant stated that AMP B.2.5 is a new one-time inspection consistent with GALL AMP XI.M32, the staff focused its evaluation on how this VCSNS AMP detects and characterizes loss of material and cracking. The staff’s evaluation of this program, which follows, is on the basis of the 10-element program as described in BTP Appendix A-1 of the SRP-LR. The 10 program elements in the GALL AMP XI.M32 for one-time inspection supply detailed programmatic characteristics and criteria that the staff considers necessary to provide additional assurance that either aging is not occurring or the evidence of aging is so insignificant that an AMP is not warranted.

The staff reviewed the program using the guidance in BTP RLSB-1 in Appendix A of the SRP-LR. The staff’s evaluation focused on management of aging effects through incorporation of the following 10 elements from RLSB-1— program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience. The applicant indicated that the corrective actions, confirmation process, and administrative controls for license renewal are in accordance with the site-controlled Quality Assurance Program. The staff’s evaluation of the applicant’s Quality Assurance Program is provided separately in Section 3.0.4 of this SER, and the evaluation of the remaining seven elements is provided below. The staff also reviewed the FSAR Supplement to determine whether it provides an adequate description of the program.

[Program Scope] The applicant stated that this AMP is applicable to stainless steel pipe exposed to an unmonitored borated water environment in the RBCU drain lines that are part of the VCSNS roof drain system. The staff finds that the systems and components monitored by the Reactor Building Cooling Unit Inspection Program, as listed in Section B.2.5 of the LRA, are within the scope of license renewal as identified in Section 2.3 of the LRA. The scope is

acceptable to the staff because it includes those components that rely on the program for aging management.

[Preventive Actions] The applicant stated that no actions are taken as part of this program to prevent the aging effects or to mitigate aging degradation. The staff did not identify the need for such preventive actions in this AMP.

[Parameters Monitored or Inspected] The applicant stated that the parameters inspected as part of this AMP include wall thickness as a measure of loss of material, and visual evidence of loss of material, cracking, or other age-related degradation. By letter dated March 28, 2003, the staff requested, in RAI B.2.5-1, that the applicant explain how visual inspection can supply information about cracking at the inside surface of piping. In its response dated June 12, 2003, the applicant stated that visual inspections will be performed for the area below the coils and that if any age-related degradation is detected, then volumetric examinations will be performed on the piping. Since the applicant demonstrated how volumetric examinations supplement visual inspections as needed in the monitoring process, the applicant's response satisfactorily addresses the staff's concerns and RAI B.2.5-1 is considered closed.

[Detection of Aging Effects] The applicant stated that the AMP will use a combination of proven volumetric and visual examination techniques at sample locations in the drain lines determined by engineering evaluation to be most susceptible to the applicable aging effects. If no parameters are known that would distinguish the susceptible locations, sample locations will be selected based on accessibility and radiological concerns and the results will be applied to the associated piping. The applicant further stated that this inspection will detect the presence and extent of any loss of material and cracking prior to a loss of component intended function. The staff finds that these inspection techniques are sufficient to provide reasonable assurance that the aging effects for the components managed by the Reactor Building Cooling Unit Inspection Program will be detected and evaluated before a component has lost its intended function. The use of one-time inspection is appropriate for inspections where degradation is possible, but is not expected on the basis of plant-specific and industry operating experience. This one-time inspection provides for additional inspections should the corrective action process require additional information to characterize the aging effects.

[Monitoring and Trending] The applicant stated that no actions are taken as a part of the Reactor Building Cooling Unit Inspection to trend inspection results. This is a one-time program used to determine if further actions are required. By letter dated March 28, 2003, the staff noted, in RAI B.2.5-2, that the ability to evaluate the appropriateness of techniques and timing of one-time inspection improves with the accumulation of plant-specific and industry-wide experience. The staff requested that the applicant address the changes that may be made in monitoring and trending (considering that certain components, although stainless steel, are exposed to an unmonitored borated water environment) in response to the discovery of boric acid-induced corrosion of the Davis-Besse vessel. The staff requested that the applicant clarify how, when inspection results reveal degraded conditions (even from a different system), additional inspections addressed in Element 7, Corrective Actions, form the basis for future monitoring and trending actions. Finally, the staff asked the applicant to identify to what extent the Boric Acid Corrosion Surveillances AMP is integrated with the Reactor Building Cooling Unit Inspection Program.

In its response dated June 12, 2003, the applicant stated there is no action to trend the inspection results because it is a one-time inspection; the objective of such inspections is to determine if further actions are required. The applicant noted that Element 7, Corrective Actions, addresses additional inspections should degradation be detected. As part of its response, the applicant stated that since RBCUs have the potential to concentrate contaminants from the reactor building atmosphere, the water environment is designated as being unmonitored. The applicant stated that a search of industry operating experience revealed an instance of boric acid crystallization in RBCU drain piping; therefore, VCSNS has conservatively deemed the environment to be unmonitored borated water. This drain piping is not pressurized nor will it experience much flow (less than 1 gallon per minute (gpm)) except under accident conditions. Because there is a potential for aging effects for stainless steel in this unmonitored borated water environment, the applicant stated that VCSNS would conduct a one-time inspection prior to the end of the current operating term.

According to GL 88-05, stainless steel and nickel-based alloys are not susceptible to boric acid corrosion; therefore, boric acid corrosion is not considered an aging effect for RBCU drains. The applicant noted that the aging effects for carbon steel components of the ventilation environment of the RBCUs are managed by the Preventive Maintenance Activities — Ventilation Systems Inspections Program. The staff was concerned that the RBCU inspection not be integrated with the Boric Acid Corrosion Surveillances Program and that inspection results showing boric acid corrosion or crystals might not be considered in the Boric Acid Corrosion Surveillances AMP. During a telecommunication July 14, 2003, the applicant identified that the RBCU inspection was not integrated with the Boric Acid Corrosion Surveillances Program. The staff requested further clarification to determine if the RBCUs are also inspected as part of the Boric Acid Corrosion Surveillances Program. If not, the applicant needed to explain how the results from the RBCU and ventilation systems inspection are considered in the Boric Acid Corrosion Program. By letter dated September 2, 2003, the applicant clarified that the scope of the Reactor Building Cooling Unit Inspection is only the stainless steel drain lines of the RBCUs and other AMPs manage other components associated with the RBCUs. Considering that engineering reviews the inspection results, it is reasonable to expect that the root cause for boric acid corrosion in the drain lines would be adequately evaluated without the need to integrate the Reactor Building Unit Cooling Unit Inspection with the Boric Acid Corrosion Surveillances. Therefore, the staff finds that the applicant's response satisfactorily addresses the staff's concerns and RAI B.2.5-2 is considered closed.

[Acceptance Criteria] The applicant stated that the acceptance criteria are no unacceptable loss of material or cracking of the subject components that could result in a loss of the component intended function(s), as determined by engineering evaluation. The staff considers this engineering evaluation to be adequate to assure that the intended functions for components in the Reactor Building Cooling Unit Inspection are maintained under all CLB design conditions during the period of extended operation.

[Operating Experience] The applicant stated that the Reactor Building Cooling Unit Inspection Program is a new one-time inspection for which there is no operating experience. By letter dated March 28, 2003, the staff requested, in RAI B.2.5-3, that the applicant present operating experience relative to leaks or degradation in the RBCU drain piping and drain pan, noting the absence or presence or any leaks or degradation. In its response dated June 12, 2003, the applicant stated that operating experience, both site-specific and industry-wide, was researched to identify the possible aging effects for various combinations of material and environment. The

applicant stated that industry operating experience revealed an instance of detecting boric acid crystallization in RBCU drain piping; therefore, this one-time inspection was developed because it was determined that the aging effects were possible, and not because they were found at VCSNS. Lastly, the applicant verified that the RBCU stainless steel drain piping at VCSNS experienced no leaks or degradation. Since the applicant verified in its response that the VCSNS operating history reveals no history of leaks or degradation of stainless steel drain piping in the RBCUs, the staff's request was satisfactorily met and RAI B.2.5-3, is considered closed.

Section 18.2.26 of Appendix A to the LRA contains the applicant's FSAR supplement for the Reactor Building Cooling Unit Inspection Program at VCSNS. The staff reviewed the FSAR Supplement and found that the description of the Reactor Building Cooling Unit Inspection Program is consistent with Section B.2.5 of the LRA. The staff finds that the information contained in the FSAR Supplement presents an adequate summary of the program activities as required by 10 CFR 54.21(d).

Conclusions

On the basis of its review and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.3.2.3.7 Service Air System Inspection Program

Summary of Technical Information in the Application

The applicant's Service Air System Inspection Program is discussed in LRA Section B.2.6, "Service Air System Inspection." The applicant stated that this is a new program and therefore summarizes the program in terms of the 10-element program as described in BTP RLSB-1 in Appendix A of the SRP-LR. The LRA credits this inspection with detecting and characterizing loss of material due to general corrosion in carbon steel pipe, tubing and valve body components in the service air, building services, and instrument air systems that are exposed internally to moist air at VCSNS. The applicant stated that this new one-time inspection activity will detect and characterize loss of material due to general corrosion resulting from exposure to an internal moist air environment. The Service Air System Inspection Program will use a combination of volumetric and visual examination techniques at the most susceptible (sample) locations (FSAR Supplement 18.2.30). The applicant stated that the Service Air System Inspection Program will be consistent with AMP XI.M32, "One-Time Inspection" in the GALL Report. The applicant also stated that this one-time inspection will be performed prior to the period of extended operation.

In Section B.2.6 of the LRA, the applicant states that the Service Air System Inspection Program will either verify that there is no aging effect requiring management for the subject

components, or ensure that appropriate corrective actions will be taken so that the component intended functions will be maintained during the period of extended operation.

Staff Evaluation

In LRA Section B.2.6, “Service Air System Inspection,” the applicant described its AMP to manage loss of material due to general corrosion in carbon steel pipe, tubing and valve body components in the service air (SA), building services (BS), and instrument air (IA) systems that are exposed internally to moist air at VCSNS. Since the applicant stated that AMP B.2.6 is a new one-time inspection consistent with GALL AMP XI.M32, the staff’s evaluation of this program, which follows, is on the basis of the 10-element program as described in BTP Appendix A of the SRP-LR. The 10 program elements in this GALL AMP XI.M32 for one-time inspection supply detailed programmatic characteristics and criteria that the staff considers necessary to provide additional assurance that either aging is not occurring, or the evidence of aging is so insignificant that an AMP is not warranted.

The staff reviewed the program using the guidance in BTP RLSB-1 in Appendix A of the SRP-LR. The staff’s evaluation focused on managing aging effects through incorporation of the following 10 elements from RLSB-1— program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience. The applicant indicated that the corrective actions, confirmation process, and administrative controls for license renewal are in accordance with the site-controlled Quality Assurance Program. The staff’s evaluation of the applicant’s Quality Assurance Program is provided separately in Section 3.0.4 of this SER; the evaluation of the remaining seven elements is provided below. The staff also reviewed the FSAR Supplement to determine whether it provides an adequate description of the program.

[Program Scope] The applicant stated that this AMP is applicable to carbon steel pipe, tubing, and valve body components exposed to an internal moist air environment that perform the function of maintaining pressure boundary for containment integrity in the following locations:

- service air system components in the supply line to the reactor building where the line penetrates the containment

- service air and building services systems components used for the leak testing of the personnel hatch, equipment hatch, and emergency personnel hatch seals

- building services system components used to supply emergency air to the personnel hatch and emergency personnel hatch

- instrument air system components in the air intake piping upstream of the instrument air dryers where the piping penetrates the containment

The staff finds that the systems and components monitored by the Service Air System Inspection Program, as listed above and in Section B.2.6 of the LRA, are within the scope of license renewal as identified in Section 2.3 of the LRA. The scope is acceptable to the staff because it includes those components that rely on the program for aging management.

[Preventive Actions] The applicant stated that no actions are taken as part of this program to prevent the aging effect or to mitigate aging degradation. By letter dated March 28, 2003, the staff noted, in RAI B.2.6-1, that accepted industry guidance and the GALL Report recommend preventive monitoring of system air quality to ensure that oil, water, rust, dirt, and other contaminants are kept within specified limits. Air quality should be maintained because instruments and components may not function properly if the air is contaminated, and the presence of oil or contaminants in the air can impact the rate and types of aging degradation. The staff requested the applicant to describe the monitoring of air quality as it relates to corrosion and degradation of the steel components within the scope of this program.

In its response dated June 12, 2003, the applicant stated that the Service Air System Inspection Program concerns specific components that are not pertinent to the quality of air supplied to safety-related equipment. These components concern the pressure boundary function of specific containment penetrations, containment hatch testing, and emergency air supply to the personnel hatches. The internal environment for these components is assumed to be ambient moist air (not dried by an air dryer). The applicant stated that the Service Air System Inspection Program is a one-time inspection to verify that aging degradation has not occurred in some specific, safety-related portions (containment integrity) of the SA, IA, and BS systems that are not designed or required to be in a dry air environment. Since the applicant demonstrated how the air quality was maintained appropriate to the systems and components within the governance of this AMP, the staff’s request was deemed to be satisfactorily answered and RAI B.2.6-1, is considered closed.

[Parameters Monitored or Inspected] The applicant stated that the parameters inspected as part of this AMP include wall thickness as a measure of loss of material and visual evidence of loss of material, cracking, or other age-related degradation. The staff finds the above parameters acceptable because they are directly related to the degradation of carbon steel components exposed to moist air-gas environments in the aforementioned systems.

[Detection of Aging Effects] The applicant stated that the AMP will use a combination of proven volumetric and visual examination techniques to inspect for general corrosion at selected sample locations to be determined by engineering evaluation. The applicant further stated that this inspection will detect the presence and extent of any loss of material and cracking prior to a loss of component intended function.

The staff finds that these inspection techniques are sufficient to provide reasonable assurance that the aging effect for the components will be detected before the loss of its intended function. The use of a one-time inspection is appropriate for inspections where degradation is possible, but is not expected on the basis of plant-specific and industry operating experience. This one-time inspection provides for additional inspections should the corrective action process require additional information to characterize the aging effects.

[Monitoring and Trending] The applicant stated that no actions are taken as a part of the Service Air System Inspection Program to trend inspection results. This is a one-time inspection used to determine if further actions are required. The staff did not identify the need for monitoring and trending in this AMP.

[Acceptance Criteria] The applicant stated that the acceptance criterion is no unacceptable loss of material or cracking of the subject components that could result in a loss of the component

intended function, as determined by engineering evaluation. The staff considers this engineering evaluation to be adequate to assure that the intended functions for components in the Service Air System Inspection Program are maintained under all CLB design conditions during the period of extended operation.

[Operating Experience] The applicant stated that the Service Air System Inspection Program is a new one-time inspection for which there is no operating experience. By letter dated March 28, 2003, the staff requested, in RAI B.2.6-2, that the applicant discuss the operating experience with the SA system, BS system, or IA system as it relates to aging degradation of these systems. Specifically, the applicant was requested to describe operating experience related to leaks or degradation in the service air system (re: GL 88-14) and to verify the presence or absence of such leaks or degradation.

In its response dated June 12, 2003, the applicant stated that the Service Air System Inspection Program concerns specific components that are not pertinent to the quality of air supplied to safety-related equipment and, therefore, not pertinent to the concerns of NRC GL 88-14. The applicant stated that this one-time inspection is used to verify that aging degradation has not occurred in some specific safety-related portions (containment integrity) of the SA system, the IA system, and the BS system that are not designed for nor required to be in, a dry air environment. The applicant stated that the carbon steel SA and IA system components that are managed by this program, function as pressure boundaries for a containment penetration and are leak tested under 10 CFR 50 Appendix J. Operating experience at VCSNS for the SA and IA components managed by this program reveals no history of aging degradation for the internal surfaces. The applicant also stated that the carbon steel BS system components that are managed by this program are the hatch seal test blocks and the emergency air valves for the hatches. Operating experience at VCSNS for the BS components managed by this program reveals no history of aging degradation for the internal surfaces. Since the applicant verified in its response that the VCSNS operating history reveals no history of leaks or degradation in internal surfaces of managed components in the SA system, the IA system, or the BS system, the staff's question was deemed to be satisfactorily answered and RAI B.2.6-2, is considered closed.

Section 18.2.30 of Appendix A to the LRA contains the applicant's FSAR Supplement for the Service Air System Inspection Program at VCSNS. The staff reviewed the FSAR Supplement and found that the description of the Service Air System Inspection Program is consistent with Section B.2.6 of the LRA. The staff finds that the information contained in the FSAR Supplement presents an adequate summary of the program activities, as required by 10 CFR 54.21(d).

<u>Conclusions</u>

On the basis of its review and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.3.2.3.8 Waste Gas System Inspection Program

Summary of Technical Information in the Application

The applicant's Waste Gas System Inspection Program is discussed in LRA Section B.2.8, "Waste Gas System Inspection." The applicant stated that this is a new program and therefore summarized the program in terms of the 10-element program as described in BTP Appendix A of the SRP-LR. The LRA credits this inspection with managing loss of material due to crevice and pitting corrosion and cracking due to SCC in unmonitored and uncontrolled treated water, and cracking due to SCC in gas environments at the VCSNS. The applicant stated that this one-time inspection activity will determine if aging management is required for certain stainless steel components of the gaseous waste processing system. This inspection will detect and characterize loss of material due to crevice and pitting corrosion in portions of the system exposed to unmonitored and uncontrolled treated water, and cracking due to SCC in portions of the system containing gas, as well as those containing untreated and unmonitored water. The Waste Gas System Inspection Program will use a combination of volumetric and visual examination techniques at the most susceptible (sample) locations (FSAR supplement 18.2.39). The applicant stated that the Waste Gas System Inspection will be consistent with AMP XI.M32, "One-Time Inspection", in the GALL Report. The applicant also stated that this one-time inspection will be performed prior to the period of extended operation.

In Section B.2.8 of the LRA, the applicant concluded that the Waste Gas System Inspection Program will either verify that there are no aging effects requiring management for the subject components, or ensure that appropriate corrective actions will be taken so that the component intended functions will be maintained during the period of extended operations.

Staff Evaluation

In LRA Section B.2.8, "Waste Gas System Inspection," the applicant described its AMP to manage loss of material due to crevice and pitting corrosion and cracking due to SCC in unmonitored and uncontrolled treated water, and cracking due to SCC in gas environments at the VCSNS. Since The applicant stated that AMP B.2.8 is a new one-time inspection consistent with GALL AMP XI.M32, the staff's evaluation of this program, which follows, is on the basis of the 10-element program described in BTP Appendix A of the SRP-LR. The 10 program elements in this GALL AMP for one-time inspection supply detailed programmatic characteristics and criteria that the staff considers necessary to provide additional assurance that either aging is not occurring, or the evidence of aging is so insignificant that an AMP is not warranted.

The staff reviewed the program using the guidance in BTP RLSB-1 in Appendix A of the SRP-LR. The staff's evaluation focused on management of aging effects through incorporation of the following 10 elements from RLSB-1— program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience. The applicant indicated that the corrective actions, confirmation process, and administrative controls for license renewal are in accordance with the site-controlled Quality Assurance Program. The staff's evaluation of the applicant's Quality Assurance Program is provided separately in Section 3.0.4 of this SER; the evaluation of the remaining seven elements is provided below.

The staff also reviewed the FSAR Supplement to determine whether it provides an adequate description of the program.

[Program Scope] The applicant stated that this AMP is applicable to the following gaseous waste processing system components — stainless steel pipe and valve bodies exposed to an unmonitored and uncontrolled treated water environment, and stainless steel tube coils and manifolds in the hydrogen recombiner cooler condenser exposed to a gas environment. Further, the applicant stated that the unmonitored and uncontrolled treated water environment consists of condensation that forms within the waste gas decay tanks and is periodically pumped to the volume control tank in the CVCS. The applicant stated that the gas environment is mostly nitrogen, with trace amounts of hydrogen, oxygen, and fission product gases and water vapor from the recombination of hydrogen and oxygen. The staff finds that the components monitored by the Waste Gas System Inspection Program, as listed above and in Section B.2.8 of the LRA, are within the scope of license renewal as identified in Section 2.3 of the LRA. The scope is acceptable to the staff because it includes those components that rely on the program for aging management.

[Preventive Actions] The applicant stated that no actions are taken as part of this program to prevent the aging effects or to mitigate aging degradation. The staff did not identify the need for preventive actions in this AMP.

[Parameters Monitored or Inspected] The applicant stated that the parameters inspected as part of this AMP include wall thickness as a measure of loss of material, and visual evidence of loss of material, cracking, or other age-related degradation. The staff finds the above parameters acceptable because they are directly related to the degradation of stainless steel components exposed to unmonitored and uncontrolled treated water or gas environments in the abovementioned systems.

[Detection of Aging Effects] The applicant stated that the AMP will use a combination of proven volumetric and visual examination techniques to inspect for general corrosion at selected sample locations to be determined by engineering evaluation. The applicant further stated that results of the inspection will be applied to the remainder of the components within the scope of the inspection activity. The applicant further stated that the sample population should consist of at least one susceptible location in the stainless steel waste gas decay tank drain piping (preferably at a low point), and at least one susceptible location in the stainless steel tube-side inlet piping to the hydrogen recombiner cooler condenser.

The staff finds that these inspection techniques are sufficient to provide assurance that the aging effects for the components managed by the Waste Gas System Inspection will be detected before a component has lost its intended function. The use of a one-time inspection is appropriate for inspections where degradation is possible, but is not expected on the basis of plant-specific and industry operating experience. This one-time inspection provides for additional inspections should the corrective action process require additional information to characterize the aging effects.

[Monitoring and Trending] The applicant stated that no actions are taken as a part of the Waste Gas System Inspection Program to trend inspection results. This is a one-time inspection used to determine if further actions are required. The staff did not identify the need for monitoring and trending in this AMP.

[Acceptance Criteria] The applicant stated that the acceptance criterion is no unacceptable loss of material or cracking of the subject components that could result in a loss of the component intended function, as determined by engineering evaluation. The staff considers this engineering evaluation to be adequate to assure that the intended functions for components in the Waste Gas System Inspection Program are maintained under all CLB design conditions during the period of extended operation.

[Operating Experience] The applicant stated that the Waste Gas System Inspection Program is a new one-time inspection for which there is no operating experience. By letter dated March 28, 2003, the staff requested, in RAI B.2.8-1, that the applicant discuss the operating experience with the gaseous waste processing system as it relates of aging degradation of these systems. In its response dated June 12, 2003, the applicant stated that the operating experience, both site-specific and industry-wide, was researched to identify the possible aging effects for various material-environment combinations; the results are retained at VCSNS. This one-time Waste Gas System Inspection Program was developed because it was determined that the aging effects were possible, and not because they were found at VCSNS. The applicant further stated that portions of the waste gas (WG) system managed by the Waste Gas Systems Inspection Program are in scope because they are pressure boundaries for the component cooling water (CC) system and the chemical and volume control (CS) system. The recombiner heat exchangers are in scope for license renewal because the tube coils and tube manifolds form a pressure boundary with the CC system, which is the cooling medium for the heat exchangers.

The applicant verified that VCSNS operating experience for the heat exchanger components managed by this program reveals no history of aging degradation for the internal surfaces. The applicant stated that WG valves and piping, managed by the Waste Gas System Inspection Program and allowing the transfer of condensation formed in the waste gas decay tanks to the volume control tank of the CS system, are in scope for license renewal because they form a pressure boundary with the CC System. The applicant finally verified that VCSNS operating experience for these components managed by the Waste Gas System Inspection Program reveals no history of aging degradation for the internal surfaces. Since the applicant demonstrated in its response that the VCSNS operating history reveals no history of aging degradation for the components managed by the Waste Gas System Inspection Program, the staff's request was deemed to be satisfactorily met and RAI B.2.8-1, is considered closed.

Section 18.2.39 of Appendix A to the LRA contains the applicant's FSAR Supplement for the Waste Gas System Inspection Program at VCSNS. The staff reviewed the FSAR Supplement and found that the description of the Waste Gas System Inspection Program is consistent with Section B.2.8 of the LRA. The staff finds that the information contained in the FSAR Supplement presents an adequate summary of the program activities, as required by 10 CFR 54.21(d).

Conclusions

On the basis of its review and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended

operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.3.2.4 Aging Management Review of Plant-Specific Auxiliary Systems Components

The following sections provide the results of the staff's evaluation of the adequacy of aging management for components in each of the auxiliary systems.

3.3.2.4.1 Air Handling And Local Ventilation and Cooling Systems

<u>Summary of Technical Information in the Application</u>

The description of the air handling and local ventilation and cooling systems can be found in Section 2.3.3.1 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3-18. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1 and 3.3-2.

Aging Effects:

Components of the air handling and local ventilation and cooling systems are described in Section 2.3.3.1 of the LRA as being within the scope of license renewal, and subject to an AMR. Tables 2.3-18, 3.3-1 and 3.3-2 of the LRA and tables entitled “Virgil C. Summer Nuclear Station Database AMR Query, " list individual components of the system including air handling units; plenums; cooling coils, including fins, headers, tubes, and tubesheets; ductwork, including fan and plenum housings; flexible connections; exhaust air relief heads; mechanical expansion joints, including expansion boots and retaining rings; heating coils; pipe; tube and tube fittings; and valves bodies.

Carbon steel components are subject to the aging effects of loss of material due to pitting, crevice, galvanic, and general corrosion and cracking due to SCC of internal surfaces from the treated water environment. Internal surfaces of carbon steel are also subject to loss of material from crevice corrosion, erosion, galvanic corrosion, general corrosion, MIC, pitting corrosion, and heat exchanger fouling from biological materials and particulates due to exposure to raw water. External surfaces of carbon steel and galvanized steel are also subject to the aging effect of loss of material from exposure to sheltered (due to boric acid corrosion) and ventilation environments (due to general corrosion for carbon steel). However, ductwork made from galvanized steel exposed to the ventilation or yard environment experiences no aging effects. Stainless steel components are subject to the aging effect of loss of material from MIC due to exposure to a sheltered environment. Exposure of internal or external surfaces of stainless steel components to a reactor building or ventilation environment has no aging effect. Copper components are subject to the aging effects of heat exchanger fouling from particulates and loss of material from crevice corrosion, erosion-corrosion, galvanic corrosion, and pitting corrosion due to exposure to raw and treated water environments. Components made of copper exposed to a reactor building and ventilation environment experience the aging effects of heat exchanger fouling due to particulates and loss of material from boric acid and galvanic corrosion. Exposure of hypalon and rubber components to a reactor building environment is subject to the aging effect of cracking from thermal and radiation embrittlement. The exposure of neoprene components to a sheltered environment is also subject to the aging effect of

cracking from thermal and radiation embrittlement. Exposure of hypalon, rubber, and neoprene components to a ventilation air environment results in aging effects.

Aging Management Programs:

The following AMPs are utilized to manage aging effects in the air handling and local ventilation and cooling systems:

- Chemistry Program (B.1.4)
- Boric Acid Corrosion Surveillances Program (B.1.2)
- Service Water System Reliability and In-Service Testing Program (B.1.9)
- Preventive Maintenance Activities — Ventilation Systems Inspections (B.1.26)
- Inspections for Mechanical Components Program (B.2.11)
- Maintenance Rule Structures Program (B.1.18)
- Heat Exchanger Inspections Program (B.2.12)

A description of these AMPs is provided in Appendix B of the LRA. The applicant concluded that the effects of aging associated with the components of the air handling and local ventilation and cooling systems will be adequately managed by these AMPs during the period of extended operation.

Staff Evaluation

Aging Effects:

The staff reviewed the information in Section 2.3.3.1 and Tables 2.3-18, 3.3-1, and 3.3-2 in the LRA, as well as in the supplementary table and notes, entitled “Virgil C. Summer Nuclear Station Database AMR Query.” During its review, the staff determined that additional information was needed.

Numerous tables included in the application list the component material and environment to which the component is exposed. However, the applicant did not provide a description of these environments in the LRA. By letter dated March 28, 2003, the staff issued RAI 3.3-1, pertaining to this issue of the plant-specific characteristics of the environment. The staff’s evaluation of the applicant’s response is documented in Section 3.3.2.5.1 of this SER, and is characterized as resolved.

For components in this system listed in the supplemental table and notes, entitled “Virgil C. Summer Nuclear Station Database AMR Query,” the applicant indicated that galvanized steel ductwork in a "yard" environment has no identified aging effects and does not require an AMP. The staff finds that this conclusion may not be justified because of factors associated with corrosive agents in the local environment and rainfall. By letter dated March 28, 2003, the staff requested, in RAI 3.3.2.4.1-1, the applicant to provide justification for the conclusion that galvanized steel ductwork in a "yard" environment has no identified aging effects.

In its response dated June 12, 2003, the applicant stated that VCSNS is located well inland and is located in an area where forestry is the primary commercial activity. VCSNS does not see salt or other corrosive materials in the air from agriculture or industry. Crevice and pitting corrosion are not considered to be aging effects for external surfaces because the ambient environment

does not contain contaminants of sufficient quantity to concentrate on external surfaces such that pitting or crevice corrosion would occur. Rainwater analyses reveal a concentration of less than 10 ppm for chlorides and sulfates.

The applicant further stated that zinc is used because of its corrosion resistance in an external environment and by its galvanic protection of the base metal when the coating is damaged. The components in question are the air exhaust heads located on the roofs of the control building and the intermediate building. Because of the relative lack of traffic and activity in these areas, damage to the zinc coating is not expected beyond small nicks, which are protected by the self-healing properties of the zinc coating. General corrosion of galvanized steel is not an aging mechanism because the ambient temperature in the area where these components are located is less than 140 ^{o}F.

On the basis of its review, the staff finds the applicant's response to RAI 3.3.2.4.1-1 acceptable because (1) VCSNS does not see salt or other corrosive materials in the air from agriculture or industry, (2) rainwater analyses reveal a concentration of less than 10 ppm for chlorides and sulfates, and (3) the ambient temperature in the area where these components are located is less than 140 ^{o}F.

For components in this system list in the supplemental table and notes, entitled "Virgil C. Summer Nuclear Station Database AMR Query," the applicant stated that carbon steel cooling coil headers in a treated water environment are subject to SCC. However, no AMP has been provided to address this aging effect. By letter dated March 28, 2003, the staff requested, in RAI 3.3.2.4.1-2, the applicant to explain why no AMP has been provided to address this aging effect.

In its response dated June 13, 2003, the applicant stated that according to industry references, SCC of carbon and low-alloy steel components is not considered to be an applicable aging mechanism in a treated water environment. Industry data do not exhibit widespread incidence of SCC in low-strength carbon steels; however, there was a reported case suspected to be nitrate-induced SCC of carbon steel in a treated water system. VCSNS has conservatively listed SCC as a possible aging mechanism in certain closed systems where nitrates are added as a corrosion inhibiter. In these closed systems, there is no other pathway for the introduction of contaminants beyond the corrosion products of the system itself. Nitrates are added as a corrosion inhibitor by the Chemistry Program at levels within EPRI guidelines; therefore, VCSNS maintains that the Chemistry Program adequately manages SCC of carbon steel components in a treated water environment.

On the basis of its review, the staff finds the applicant's response acceptable because the applicant has properly identified that the Chemistry Program will be used to manage SCC of carbon steel components in a treated water environment. However, the staff questioned whether a one-time inspection is used to verify the effectiveness of the Chemistry Program. The staff notes that the response to RAI 3.3.2.4.4-1, clarified that a one-time inspection will be conducted in low-flow areas of various closed, treated water systems to demonstrate the effectiveness of the Chemistry Program.

In its response dated September 2, 2003, the applicant stated that VCSNS has conservatively listed SCC as a possible aging mechanism in certain closed systems where nitrites are added as a corrosion inhibiter. Nitrites do not cause SCC of carbon and low-alloy steel components;

however, nitrites can convert to nitrates in the presence of microorganisms. Nitrate levels in these systems are typically in the range of 300 ppm. According to EPRI guidelines, nitrate-induced SCC occurs at levels above 10,000 ppm. In these closed systems, there is no other pathway for the introduction of contaminants beyond the corrosion products of the system itself. Nitrites are added as a corrosion inhibiter by the Chemistry Program at levels within EPRI guidelines; therefore, VCSNS maintains that the Chemistry Program adequately manages SCC of carbon steel components in a treated water environment. The applicant also stated that one-time inspections will be performed in low-flow areas prior to the period of extended operation to verify the effectiveness of the Chemistry Program to manage aging in the various chemistry regimes within the scope for license renewal.

On the basis of its review, the staff finds the applicant's response acceptable because that the applicant has committed to performing one-time inspections in low-flow areas prior to the period of extended operation to verify the effectiveness of the Chemistry Program to manage aging in the various chemistry regimes within the scope for license renewal.

The aging effects identified in the LRA for the components in the air handling and local ventilation and cooling systems are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs:

The applicant credited the following AMPs for managing the aging effects in the air handling and local ventilation and cooling systems:

- Chemistry Program (3.0.3.2)
- Boric Acid Corrosion Surveillances Program (3.0.3.1)
- Service Water System Reliability and In-Service Testing Program (3.3.2.3.1)
- Preventive Maintenance Activities — Ventilation Systems Inspections Program (3.3.2.3.3)
- Inspections for Mechanical Components Program (3.0.3.7)

6. Maintenance Rule Structures Program (3.0.3.4)

- Heat Exchanger Inspections Program (3.0.3.8)

The Chemistry Program, Boric Acid Corrosion Surveillances Program, Inspections for Mechanical Components Program, Maintenance Rule Structures Program, and Heat Exchanger Inspections Program are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common AMPs. The staff has evaluated these common AMPs and has found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Sections 3.0.3.1, 3.0.3.2 , 3.0.3.4, 3.0.3.7, and 3.0.3.8 of this SER.

The staff evaluated the system-specific AMPs of Service Water System Reliability and In-Service Testing Program and Preventive Maintenance Activities — Ventilation Systems Inspections Program and finds them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Sections 3.3.2.3.1 and 3.3.2.3.3 of this SER.

After evaluating the applicant's AMR for each of the components in the air handling and local ventilation and cooling systems, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects for this system. For those components identified in Table 3.3-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.3-2, the staff verified that the applicant credited AMPs that are appropriate for the identified aging effects.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the components in the air handling and local ventilation and cooling systems will effectively manage or monitor the aging effects identified in the LRA.

Conclusions

On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.4.2 Boron Recycle System

Summary of Technical Information in the Application

The description of the boron recycle system can be found in Section 2.3.3.2 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3-19. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1 and 3.3-2.

Aging Effects:

Components of the boron recycle system are described in Section 2.3.3.2 of the LRA as being within the scope of license renewal and subject to an AMR. Tables 2.3-19, 3.3-1, and 3.3-2 of the LRA, and the supplementary table and notes, entitled "Virgil C. Summer Nuclear Station Database AMR Query," list system components and component group.

The component groups in this category of the boron recycle system listed by the applicant in the VCSNS LRA include condensers (XEV0008-CN1, XEV0008-CN2) recycle evaporator-channel head; condensers (XEV0008-CN1, XEV0008-CN2) recycle evaporator-channel head (Nozzles); condensers (XEV0008-CN1, XEV0008-CN2) recycle evaporator-tubes; condensers (XEV0008-CN1, XEV0008-CN2) recycle evaporator-tubesheet; heat exchanger (XEV0008-HE2) recycle evaporator-shell; heat exchanger (XEV0008-HE2) recycle evaporator-shell (Nozzles); heat exchanger (XEV0008-HE2), recycle evaporator-tubes; heat exchanger (XEV0008-HE2) recycle evaporator-tubesheet; heat exchanger (XHE0021) recycle evaporate concentrates sample-manifolds; heat exchanger (XHE0021) recycle evaporate concentrates sample-shell; heat exchanger (XHE0021) recycle evaporate concentrates sample-tubes; and valves (body only).

Carbon steel and stainless steel components exposed to borated water, treated water, or sheltered environments are subject to the aging effects of loss of material from general (for carbon steel only), pitting, and crevice corrosion, boric acid corrosion, and galvanic corrosion

(for carbon steel only) and cracking from SCC (for stainless steel only). Stainless steel components exposed to a sheltered environment in the boron recycle system experience no aging effects.

Aging Management Programs:

The following AMPs are utilized to manage aging effects in the boron recycle system:

- Chemistry Program (B.1.4)
- Boric Acid Corrosion Surveillances Program (B.1.2)

A description of these AMPs is provided in Appendix B of the LRA. The applicant indicated that the effects of aging associated with the components of the boron recycle system will be adequately managed by these AMPs during the period of extended operation.

Staff Evaluation

Aging Effects:

The staff reviewed the information in Section 2.3.3.2 and Tables 2.3-19, 3.3-1, and 3.3-2 in the LRA, as well as in the tables entitled, "Virgil C. Summer Nuclear Station Database AMR Query" and "Virgil C. Summer Nuclear Station Database AMR Query Notes," in the supplement and finds the applicant's identification of the applicable aging effects of carbon steel and stainless steel components acceptable. The applicant's conclusion that the stainless steel valves (body only) in the sheltered environment experience no aging effects is also acceptable.

Aging Management Programs:

The applicant credited the following AMPs for managing the aging effects in the boron recycle system:

- Chemistry Program (3.0.3.2)
- Boric Acid Corrosion Surveillances Program (3.0.3.1)

The Chemistry Program and the Boric Acid Corrosion Surveillances Program are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common AMPs. The staff has evaluated these common AMPs and has found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Sections 3.0.3.1 and 3.0.3.2, respectively, of this SER.

After evaluating the applicant's AMR for each of the components in the boron recycle system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects for this system. For those components identified in Table 3.3-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.3-2 , the staff verified that the applicant credited AMPs that are appropriate for the identified aging effects.

On the basis of its review, the staff finds that the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with the boron recycle system. In addition, the staff finds the associated program descriptions in the FSAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

Conclusions

On the basis of its review and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.3.2.4.3 Building Services System

Summary of Technical Information in the Application

The description of the building services system can be found in Section 2.3.3.3 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3-20. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1 and 3.3-2.

Aging Effects:

Components in the building services system are described in Section 2.3.3.3 of the LRA as being within the scope of license renewal and subject to an AMR. Tables 2.3-20, 3.3-1, and 3.3-2 of the LRA, and the supplementary table and notes, entitled "Virgil C. Summer Nuclear Station Database AMR Query," list system components and component group.

The component groups in this category in the building services system listed by the applicant in the VCSNS LRA include pipe and fittings, tube and tube fittings, and valves (body only). The applicant stated that the stainless steel components exposed to air-gas, reactor building, ventilation, and sheltered environments in building services experience no aging effect. Carbon steel components in the air-gas and sheltered environments are subject to the aging effects of loss of material due to galvanic corrosion and general corrosion. Carbon steel components exposed to a sheltered environment are subject to the aging effect of loss of material due to boric acid corrosion.

Aging Management Programs:

The following AMPs are utilized to manage aging effects in the building services system:

- Boric Acid Corrosion Surveillances Program (B.1.2)
- Service Air System Inspection Program (B.2.6)
- Inspections for Mechanical Components Program (B.2.11)

A description of these AMPs is provided in Appendix B of the LRA. The applicant indicated that the effects of aging associated with the components of the building services system will be adequately managed by these AMPs during the period of extended operation.

Staff Evaluation

Aging Effects:

The staff reviewed the information in Section 2.3.3.3 and Tables 2.3-20, 3.3-1, and 3.3-2 in the LRA, as well as in the tables entitled "Virgil C. Summer Nuclear Station Database AMR Query" and "Virgil C. Summer Nuclear Station Database AMR Query Notes" in the supplement. During its review, the staff found that additional information was needed.

In the LRA Table 3.3-2, Item 11, the applicant stated that no aging effect was identified for the stainless steel piping and fittings in the air-gas environment. However, in the AMR Query Notes, "A-BS-c," the applicant stated the following:

> "Loss of material due to corrosive impacts of alternate wetting and drying are aging effects for stainless steel exposed to a ventilation environment, and subject to alternate wetting and drying that may concentrate contaminates. A review of the Air-Gas System Screening Report [TR00160-006], Attachment I and associated references determined that there are stainless steel components within the license renewal evaluation boundaries of the BS system, which are exposed to alternative wetting and drying in the ventilation environment. Therefore, loss of materials and cracking due to corrosive impacts of alternative wetting and drying are not aging effects requiring management of stainless steel components/component types of the BS system exposed to the ventilation environment."

By letter dated March 28, 2003, the staff requested, in RAI 3.3.2.4.3-1, the applicant to clarify, with justification, the above quoted statements in LRA Table 3.3-2, Item 11 and the AMR Query Notes "A-BS-c."

In its response dated June 12, 2003, the applicant stated that Notes "A-BS-c" are incorrect and that there are no stainless steel components within the license renewal evaluation boundaries of the building services system.

On the basis of its review, the staff finds the applicant's response acceptable because the applicant has clarified that Notes "A-BS-c" are incorrect and that there are no stainless steel components within the license renewal evaluation boundaries of the building services system.

Aging Management Programs:

The applicant credited the following AMPs for managing the aging effects in the building services system:

- Boric Acid Corrosion Surveillances Program (3.0.3.1)
- Service Air System Inspection Program (3.3.2.3.7)
- Inspections for Mechanical Components Program (3.0.3.7)

The Boric Acid Corrosion Surveillances and the Inspections for Mechanical Components AMPs are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common AMPs. The staff has evaluated these

common AMPs and has found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Sections 3.0.3.1 and 3.0.3.7, respectively, of this SER.

The staff has evaluated the system-specific Service Air System Inspection AMP and has found it to be acceptable for managing the aging effects identified for this system. The staff's evaluation of this AMP is documented in Section 3.3.2.3.7 of this SER.

Conclusions

On the basis of its review and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.3.2.4.4 Chilled Water System

Summary of Technical Information in the Application

The description of the chilled water system can be found in Section 2.3.3.4 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3-21. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1 and 3.3-2.

Aging Effects:

Tables 2.3-21, 3.3-1, and 3.3-2 of the LRA and the table entitled "Virgil C. Summer Nuclear Station Database AMR Query," in the supplement list individual components of the system including pumps and pump casings, condenser shells, fins, tubes, tubesheets, water boxes, evaporator shells, orifices, pipe and fittings, tube and tube fittings, valve bodies, compressor housings, flow control chambers, eductor pumps, lubrication system eductors, filters, purge units, tanks, and sight glasses.

Carbon steel components are subject to the aging effects of loss of material due to crevice corrosion, galvanic corrosion, general corrosion, and pitting corrosion and cracking of internal surfaces due to SCC from a treated water environment. Internal surfaces of carbon steel are also subject to loss of material due to galvanic corrosion, general corrosion, MIC, and pitting corrosion, and heat exchanger fouling from particulates and biological materials due to exposure to raw water. External surfaces of carbon steel are also subject to the aging effect of loss of material due to galvanic corrosion, general corrosion, and pitting corrosion from exposure to sheltered and yard environments. Exposure of internal or external carbon steel surfaces to oil environments has no aging effects. Internal surfaces of stainless steel components are subject to the aging effect of loss of material from crevice corrosion and pitting corrosion due to exposure to a treated water environment. Exposure of internal or external surfaces of stainless steel components to a sheltered or oil environment has no aging effect.

Cast iron external surfaces exposed to sheltered environments are subject to the aging effect of loss of material from galvanic corrosion, general corrosion, and pitting corrosion. Exposure of internal or external surfaces of cast iron or copper components to an air or dry gas environment has no aging effect. Internal surfaces of copper components are subject to the aging effects of heat exchanger fouling from particulates, and biological materials, and loss of material due to crevice corrosion, erosion, MIC, and pitting corrosion from exposure to raw and treated water environments. Exposure of glass components to an air, dry gas, or sheltered environment results in no aging effects.

Aging Management Programs:

The following AMPs are utilized to manage aging effects in the chilled water system:

- Chemistry Program (B.1.4)
- Inspections for Mechanical Components Program (B.2.11)
- Service Water System Reliability and In-Service Testing Program (B.1.9)
- Above Ground Tank Inspection Program (B.2.1)
- Heat Exchanger Inspections Program (B.2.12)
- Maintenance Rule Structures Program (B.1.18)

A description of these AMPs is provided in Appendix B of the LRA. The applicant indicated that the effects of aging associated with the components of the chilled water system will be adequately managed by these AMPs during the period of extended operation.

<u>Staff Evaluation</u>

Aging Effects:

The staff reviewed the information in Section 2.3.3.4 and Tables 2.3-21, 3.3-1, and 3.3-2 in the LRA, as well as in the tables entitled “Virgil C. Summer Nuclear Station Database AMR Query” and “Virgil C. Summer Nuclear Station Database AMR Query Notes” in the supplement. During its review, the staff determined that additional information was needed.

Numerous tables included in the application list the component material and environment to which the component is exposed. However, the applicant did not provide a description of these environments in the LRA. By letter dated March 28, 2003, the staff issued RAI 3.3-1, pertaining to this issue of the plant-specific characteristics of the environment. The staff’s evaluation of the applicant’s response is documented in Section 3.3.2.5.1 of this SER and is characterized as resolved.

LRA Table 3.3-2, Item 19 credits the Above Ground Tank Inspection Program (B.2.1), and the Chemistry Program (B.1.4), for managing loss of material and cracking of the internal surfaces of the chilled water expansion tanks (XTK0174A/B) during the period of extended operation. The staff identified a concern that this inspection may not be adequate to detect significant tank degradation in inaccessible locations, such as tank bottom surfaces. By letter dated March 28, 2003, the staff requested, in RAI 3.3.2.4.4-1, the applicant to provide assurance that significant tank degradation in inaccessible locations, such as tank bottom surfaces, is adequately managed.

In its response by letter dated June 12, 2003, the applicant provided the following clarification. The Above Ground Tank Inspection Program manages the internal surfaces of tanks. This program inspects the tanks at the liquid/air-gas interface where degradation is more likely to be found due to alternate wetting and drying which causes contaminants to concentrate. The Chemistry Program has proven effective in managing aging effects in the treated water environment. The applicant further stated that prior to the period of extended operation, one-time inspections will be conducted in low-flow areas of various closed, treated water systems to demonstrate the effectiveness of the Chemistry Program.

On the basis of its review, the staff finds that the applicant's response to RAI 3.3.2.4.4-1, is acceptable because, prior to the period of extended operation, one-time inspections will be conducted in low-flow areas of various closed, treated water systems to demonstrate the effectiveness of the Chemistry Program. All issues associated with RAI 3.3.2.4.4-1, are considered resolved.

LRA Table 3.3-1, Item 5 credits the Inspections of Mechanical Components Program (B.2.11) for managing loss of material of the external surfaces of the carbon steel chilled water expansion tanks (XTK0174A/B) during the period of extended operation. The staff identified that this conclusion does not appear adequate to detect significant tank degradation in inaccessible locations, such as under insulation or the external tank bottom surfaces. By letter dated March 28, 2003, the staff requested, in RAI 3.3.2.4.4-2, the applicant to provide assurance that significant tank degradation in the inaccessible locations of these tanks, such as segments under insulation or the external tank bottom surfaces, are adequately managed.

In its response by letter dated June 12, 2003, the applicant provided the following clarification. External surfaces of tanks will be managed by the Inspections for Mechanical Components Program. Tank foundations will be inspected by the Maintenance Rule Structures Program. The chilled water expansion tanks are elevated such that the tank bottoms are exposed. Also, VCSNS operating experience has identified an instance of pitting of an insulated external surface for the chilled water system; therefore, the Inspections for Mechanical Components Program will involve removal of insulation from portions of the chilled water system.

On the basis of its review, the staff finds that the applicant's response to RAI 3.3.2.4.4-2 is acceptable because the chilled water expansion tanks are elevated such that the tank bottoms are exposed, and that the Inspections for Mechanical Components Program will involve removal of insulation from portions of the chilled water system. All issues associated with RAI 3.3.2.4.4-2, are considered resolved.

The table entitled, "Virgil C. Summer Nuclear Station Database AMR Query," states that carbon steel components, such as pump casings, evaporator tubesheets, and water boxes, valve bodies, pipe and fittings, and tanks in a treated water environment are subject to SCC. The staff finds that the Chemistry Program may not be adequate to manage this aging effect because it does not contain a one-time inspection of these components at susceptible locations to verify the absence of cracking and the effectiveness of the Chemistry Program. By letter dated March 28, 2003, the staff requested, in RAI 3.3.2.4.4-3, the applicant to justify the absence of an inspection/verification activity for the Chemistry Program.

In its response by letter dated June 12, 2003, the applicant stated that according to industry references, SCC of carbon and low-alloy steel components is not considered to be an

applicable aging mechanism in a treated water environment. Industry data do not exhibit widespread incidence of SCC in low-strength carbon steels; however, there was a reported case suspected to be nitrate-induced SCC of carbon steel in a treated water system. VCSNS has conservatively listed SCC as a possible aging mechanism in certain closed systems where nitrates are added as a corrosion inhibitor. In these closed systems, there is no other pathway for the introduction of contaminants beyond the corrosion products of the system itself. The applicant stated that nitrates are added as a corrosion inhibitor by the Chemistry Program at levels within EPRI guidelines; therefore, VCSNS maintains that the Chemistry Program adequately manages SCC of carbon steel components in a treated water environment.

On the basis of its review of the above information, the staff further requested the applicant to clarify whether any aging management activity is used to verify the absence of cracking and the effectiveness of the Chemistry Program and if so, what AMP is used. Otherwise, the applicant was requested to provide the justification for not verifying the effectiveness of the Chemistry Program.

In its response by letter dated September 2, 2003, the applicant stated that VCSNS has conservatively listed SCC as a possible aging mechanism in certain closed systems where nitrites are added as a corrosion inhibitor. Nitrites do not cause SCC of carbon and low-alloy steel components; however, nitrites can convert to nitrates in the presence of microorganisms. Nitrate levels in these systems are typically in the range of 300 ppm. According to EPRI guidelines, nitrate-induced SCC occurs at levels above 10,000 ppm. In these closed systems, there is no other pathway for the introduction of contaminants beyond the corrosion products of the system itself. Nitrites are added as a corrosion inhibitor by the Chemistry Program at levels within EPRI guidelines. In addition, the applicant stated that one-time inspections will be performed in low-flow areas prior to the period of extended operation to verify the effectiveness of the Chemistry Program to manage aging in the various chemistry regimes within the scope for license renewal.

On the basis of its review, the staff finds that the applicant’s response dated June 12, 2003, as well as the applicant’s supplemental response dated September 2, 2003, acceptable because the applicant has committed to perform one-time inspections in low-flow areas prior to the period of extended operation to verify the effectiveness of the Chemistry Program to manage aging in the various chemistry regimes within the scope for license renewal. All issues associated with RAI 3.3.2.4.4-3, are considered resolved.

On the basis of its review of the information provided in the LRA and the additional information included in the applicant’s response to the above RAIs, the staff finds that the aging effects that result from contact of the chilled water system SSCs to the environments described in Tables 2.3-21, 3.3-1, and 3.3-2 are consistent with industry experience for these combinations of materials and environments. Therefore, the staff finds that the applicant has identified the appropriate aging effects for the materials and environments associated with the components in the chilled water system.

Aging Management Programs:

The applicant credited the following AMPs for managing the aging effects in the chilled water system:

- Chemistry Program Program (3.0.3.2)
- Inspections for Mechanical Components Program (3.0.3.7)
- Service Water System Reliability and In-Service Testing Program (3.3.2.3.1)
- Above Ground Tank Inspection Program (3.0.3.5)
- Heat Exchanger Inspection Program (3.3.0.8)
- Maintenance Rule Structures Program (3.0.3.4)

The Chemistry Program, Inspections for Mechanical Components Program, Above Ground Tank Inspection Program, Heat Exchanger Inspections Program, and Maintenance Rule Structures Program are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Sections 3.0.3.2, 3.0.3.4, 3.0.3.5, 3.0.3.7, and 3.3.0.8, respectively, of this SER.

The staff has evaluated the system-specific Service Water System Reliability and In-Service Testing Program and finds it to be acceptable for managing the aging effects identified for this system. The staff's evaluation of this AMP is documented in Section 3.3.2.3.1 of this SER.

After evaluating the applicant's AMR for each of the components in the chilled water system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects for this system. For those components identified in Table 3.3-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.3-2, the staff verified that the applicant credited AMPs that are appropriate for the identified aging effects.

On the basis of its review, the staff finds that the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with the chilled water system. In addition, the staff finds the associated program descriptions in the FSAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

Conclusions

On the basis of its review and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.3.2.4.5 Circulating Water System

As described in Section 2.3.3.5 of the LRA, the applicant's scoping and screening review concluded that there are no mechanical components/component types required for the circulating water system to perform its system intended function; therefore, no AMR is required. The staff's evaluation of the scoping and screening process is documented in Section 2.3.3.5 of this SER.

3.3.2.4.6 Component Cooling Water System

Summary of Technical Information in the Application

The description of the sampling system can be found in Section 2.3.3.6 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3-22. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1 and 3.3-2.

Aging Effects:

Components of the component cooling system are described in Section 2.3.3.6 of the LRA as being within the scope of license renewal and subject to an AMR. Tables 2.3-22, 3.3-1, and 3.3-2 of the LRA, and the supplementary table and notes, entitled “Virgil C. Summer Nuclear Station Database AMR Query,” list individual components of the system including pipes, valve bodies, flex hoses, heat exchangers, coolers, tanks, orifices, thermowells/piping, pump casings, and tube/tube fittings.

Stainless steel components are identified as being subject to heat exchanger fouling due to particulates and biological materials (for raw water), cracking due to SCC, and loss of material due to crevice corrosion (for treated water), erosion, MIC, and pitting corrosion (for treated water) from exposure to the environments of raw water and treated water. Exposure of stainless steel to sheltered and reactor building environments has no aging effects. Carbon steel components are subject to the aging effect of loss of material due to galvanic corrosion, general corrosion, pitting corrosion, and crevice corrosion from an environment of treated water. Carbon steel can also experience the aging effects of loss of material due to crevice corrosion, erosion, galvanic corrosion, general corrosion, MIC, and pitting corrosion, and heat exchanger fouling due to particulates and biological materials from raw water. Carbon steel is also subject to loss of material from external surfaces due to boric acid corrosion from exposure to sheltered and reactor building environments. Exposure of carbon steel components to a ventilation environment leads to the aging effect of loss of material from general corrosion. Copper-nickel exposed to a treated water environment is subject to the aging effects of heat exchanger fouling from particulates and loss of material from crevice corrosion, galvanic corrosion, and pitting corrosion. Exposure of carbon-nickel and aluminum components to a ventilation environment leads to the aging effect of heat exchanger fouling from particulates.

Aging Management Programs:

The following AMPs are utilized to manage aging effects in the component cooling system:

- Chemistry Program (B.1.4)
- Boric Acid Corrosion Surveillances Program (B.1.2)
- Service Water System Reliability and In-Service Testing Program (B.1.9)
- Above Ground Tank Inspection Program (B.2.1)
- Heat Exchanger Inspections Program (B.2.12)
- Maintenance Rule Structures Program (B.1.18)
- Preventive Maintenance Activities—Ventilation Systems Inspections Program (B.1.26)

A description of these AMPs is provided in Appendix B of the LRA. The applicant indicated that the effects of aging associated with the components of the component cooling system will be adequately managed by these AMPs during the period of extended operation.

Staff Evaluation

Aging Effects:

The staff reviewed the information in Section 2.3.3.6 and Tables 2.3-22, 3.3-1, and 3.3-2 in the LRA, as well as in the supplementary table and notes, entitled "Virgil C. Summer Nuclear Station Database AMR Query." During its review, the staff determined that additional information was needed.

Numerous tables included in the application list the component material and environment to which the component is exposed. However, the applicant did not provide a description of these environments in the LRA. By letter dated March 28, 2003, the staff issued RAI 3.3-1, pertaining to this issue of the plant-specific characteristics of the environment. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.1 of this SER and is characterized as resolved.

Selective leaching is known to affect copper-nickel in aqueous environments with nickel being the element removed. Preventive measure involves proper selection of an alloy/environment combination. For copper-nickel components in a treated water environment, the applicant stated in the supplementary table and notes, entitled "Virgil C. Summer Nuclear Station Database AMR Query," that loss of material due to selective leaching was determined not to be an aging effect for VCSNS. By letter dated March 28, 2003, the staff requested, in RAI 3.3.2.4.6-1, the applicant to provide the basis for this conclusion, including specific information on materials composition and environmental conditions that enabled the applicant to have made this determination.

In its response dated June 12, 2003, the applicant stated that selective leaching is an applicable mechanism for copper alloys that do not contain inhibiting elements. In particular, copper-zinc alloys containing greater than 15 percent zinc, copper-aluminum alloys containing greater than 8 percent aluminum, yellow brass (30 percent zinc and 70 percent copper), and muntz metal (40 percent zinc and 60 percent copper) are all susceptible to selective leaching. Copper-nickel does not fit these criteria and management is not needed in treated water, oil (fuel in wetted locations), or air/gas (wetted locations) environments. Finally, the applicant stated that in identifying aging effects for raw water environments, selective leaching was attributed as an aging effect for copper-nickel in harsh raw water environments only; however, VCSNS has no in-scope copper-nickel components in a raw water environment.

On the basis of its review, the staff finds the applicant's response acceptable because the applicant has properly identified selective leaching as an aging effect for copper-nickel in harsh raw water environments only, and the applicant stated that VCSNS has no in-scope copper-nickel components in a raw water environment. All issues associated with this RAI 3.3.2.4.6-1, are considered resolved.

For stainless steel components in a reactor building environment, the applicant stated that for VCSNS no aging effects were determined to require aging management during the period of

extended operation. By letter dated March 28, 2003, the staff requested, in RAI 3.3.2.4.6-2, the applicant to provide the basis for this conclusion. In particular, in view of the operational experience described in IN 85-30, "Microbiologically-Induced Corrosion of Containment Service Water System," the applicant was requested to explain why MIC is not an applicable aging mechanism leading to loss of material as an aging effect in the VCSNS reactor building environment. In addition, for stainless steel components in a sheltered environment, the applicant stated that for VCSNS the aging effect of loss of material due to pitting and crevice corrosion was determined not to require aging management. The applicant was requested to provide the basis for its conclusion.

In its response dated June 12, 2003, the applicant provided the following clarification. IN 85-30 refers to MIC in internal environments; the reactor building environment concerns external surfaces in the ambient environment of the reactor building. In addition, the applicant stated that plant operating experience has identified the accumulation of microbiological organisms on the external surfaces of some piping components at building wall penetrations as a result of ground water intrusion effects. The structural design of the plant is such that any ground water intrusion in the sheltered environment is directed to sumps and away from equipment within the scope of license renewal. It is the residual presence of microbiological organisms that is of concern for subject mechanical components.

The applicant further stated that the VCSNS FSAR identifies a ground water elevation of 420' +/- 3'. Certain structures, such as the service water pumphouse, are potentially exposed to a ground water level of 425'. As such, piping, process tubing, and ductwork component types were conservatively considered to be susceptible to external MIC if they either enter a building from outside or pass between buildings included in the sheltered environment below the 425' elevation. Additionally, the susceptibility to external MIC was limited locally to the area of the interface with the pertinent wall. For building fire seal penetrations in the sheltered environment, the management of aging of the pertinent structural commodities precludes the accumulation of the necessary microbiological organisms, and thus MIC, on interfacing mechanical component types. The reactor building environment does not have the conditions necessary for MIC to be found on external surfaces. Piping, process tubing, or ductwork that penetrate the reactor building do not enter the building at locations where ground water is found.

VCSNS is located well inland and in an area where forestry is the prime commercial activity. VCSNS does not see salt or other corrosive materials in the air from agriculture or industry. Crevice and pitting corrosion are not considered to be aging effects for external surfaces because the ambient environment does not contain contaminants of sufficient quantity to concentrate on external surfaces such that pitting or crevice corrosion would occur. Finally, the applicant stated that rainwater analyses reveal a concentration of less than 10 ppm for chlorides and sulfates.

On the basis of its review, the staff finds the applicant's response to RAI 3.3.2.4.6-2 acceptable because the applicant has properly identified that the susceptibility to external MIC is limited locally to the external surfaces of some piping components at building wall penetrations as a result of ground water intrusion effects. Furthermore, the applicant stated that the ambient environment does not contain contaminants of sufficient quantity to concentrate on external surfaces such that pitting or crevice corrosion would occur. However, the staff questioned whether there are types of water other than ground water from intrusion (such as water from

condensation) present in the sheltered environment such that loss of material from MIC may become an aging effect for the external surfaces of some of the applicable components of this system. The applicant was requested to provide the justification, including operating experience, for not considering MIC from other types of water.

In its response dated September 2, 2003, the applicant stated that the ambient environment does not contain the nutrients necessary to promote external MIC in other types of water, such as water from condensation, and that, because external MIC has not been found at locations other than building penetrations, VCSNS does not specifically credit the Inspections for Mechanical Components Program for aging management of this aging effect. However, the applicant further stated that the Inspections for Mechanical Components Program will inspect for any abnormalities on external surfaces.

On the basis of its review, the staff finds the applicant's response acceptable because the applicant has properly identified that the ambient environment does not contain the nutrients necessary to promote external MIC in other types of water, such as water from condensation, and the applicant has committed to use the Inspections for Mechanical Components Program to inspect for any abnormalities on external surfaces. All issues associated with this RAI 3.3.2.4.6-2, are considered resolved.

The applicant identified galvanic corrosion as an applicable aging effect for carbon steel components in a treated water environment and the Chemistry Program as the applicable AMP. It should be noted that the likely material/locations determining galvanic corrosion rates depend on which specific metal/alloy is used, how far apart the two dissimilar metals are on the galvanic series chart, the electrolyte conductivity, geometric factors, and immersion time. Given these factors, by letter dated March 28, 2003, the staff requested in RAI 3.3.2.4.6-3, the applicant to provide the basis that the Chemistry Program is the applicable AMP for galvanic corrosion.

In its response dated June 12, 2003, the applicant stated that the Chemistry Program is credited with maintaining a high purity environment that has low electrolyte conductivity by maintaining chemistry within EPRI guidelines. The Chemistry Program has proven effective in managing aging effects in the treated water environment as evidenced by the review of operating history in response to GL 89-13. However, the applicant proposed to conduct, prior to the period of extended operation, one-time inspections in low-flow areas of various closed, treated water systems to demonstrate the effectiveness of the Chemistry Program.

On the basis of its review, the staff finds the applicant's response acceptable because prior to the period of extended operation, the applicant will conduct one-time inspections in low-flow areas of various closed, treated water systems to demonstrate the effectiveness of the Chemistry Program. All issues associated with this RAI 3.3.2.4.6-3, are considered resolved.

The applicant credited its Chemistry Program (which explicitly exempts the one-time inspection) for managing the aging effects of loss of material and cracking for some subcomponents in heat exchangers in several auxiliary systems (e.g., tubes in a heat exchanger in the component cooling water system, page 31 of 413 of the database AMR query). By letter dated March 28, 2003, the staff requested , in RAI 3.3.2.4.6-4, the applicant to explain how the credited Chemistry Program alone will ensure the heat transfer function of the subcomponents in the heat exchanger.

In its response dated June 12, 2003, the applicant stated that for closed, treated water systems, such as the CC system, contaminants have no way of entering the system other than corrosion of the system itself. Due to the continuous, turbulent flow through the shell of the CC heat exchanger, corrosion products will not settle out on tubes. The Chemistry Program will manage the conditions required for loss of material by maintaining chemistry within EPRI guidelines. The Chemistry Program has proven effective in managing aging effects in the treated water environment, as evidenced by the review of operating history provided in response to GL 89-13. However, the applicant proposed to conduct that prior to the period of extended operation, one-time inspections in low-flow areas of various closed, treated water systems to demonstrate the effectiveness of the Chemistry Program.

On the basis of its review, the staff finds the applicant's response acceptable because prior to the period of extended operation, the applicant will conduct one-time inspections in low-flow areas of various closed, treated water systems to demonstrate the effectiveness of the Chemistry Program. All issues associated with this RAI 3.3.2.4.6-4, are considered resolved.

On the basis of its review of the information provided in the LRA and the additional information included in the applicant's response to the above RAIs, the staff finds that the aging effects that result from contact of the component cooling water system SSCs to the environments described in Tables 2.3-22, 3.3-1, and 3.3-2 are consistent with industry experience for these combinations of materials and environments. Therefore, the staff finds that the applicant has identified the appropriate aging effects for the materials and environments associated with the components in the component cooling water system.

Aging Management Programs:

The applicant credits the following AMPs for managing the aging effects in the component cooling water system:

- Chemistry Program (3.3.0.2)
- Boric Acid Corrosion Surveillances Program (3.3.0.1)
- Service Water System Reliability and In-Service Testing Program (3.3.2.3.1)
- Above Ground Tank Inspection Program (3.3.0.5)
- Heat Exchanger Inspections Program (3.3.0.8)
- Maintenance Rule Structures Program (3.3.0.4)
- Preventive Maintenance Activities—Ventilation Systems Inspections Program (3.3.2.3.3)

The Chemistry Program, Boric Acid Corrosion Surveillances Program, Above Ground Tank Inspection Program, Heat Exchanger Inspections Program, and Maintenance Rule Structures Program are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Sections 3.0.3.1, 3.0.3.2, 3.0.3.4, 3.0.3.5, and 3.0.3.8, respectively, of this SER.

The staff has evaluated the system-specific AMPs, Service Water System Reliability and In-Service Testing Program and Preventive Maintenance Activities—Ventilation Systems Inspections Program, and has found them to be acceptable for managing the aging effects

identified for this system. The staff's evaluation of these AMPs is documented in Sections 3.3.2.3.1 and 3.3.2.3.3, respectively, of this SER.

After evaluating the applicant's AMR for each of the components in the Component Cooling Water System, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects for this system. For those components identified in Table 3.3-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.3-2, the staff verified that the applicant credited AMPs that are appropriate for the identified aging effects.

On the basis of its review, the staff finds that the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with the component cooling water system. In addition, the staff finds the associated program descriptions in the FSAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

Conclusions

The staff reviewed the information in Section 2.3.3.6 and Tables 2.3-22, 3.3-1, and 3.3-2, as well as in the supplementary table and notes, entitled "Virgil C. Summer Nuclear Station Database AMR Query." On the basis of its review and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.3.2.4.7 Diesel Generator Service Systems

Summary of Technical Information in the Application

The description of the diesel generator service systems can be found in Section 2.3.3.7 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3-23. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1 and 3.3-2.

Aging Effects:

Components of the diesel generator service systems are described in Section 2.3.3.7 of the LRA as being within the scope of license renewal and subject to AMR. Table 2.3-23, 3.3-1, and 3.3-2 of the LRA, and the supplementary table and notes, entitled "Virgil C. Summer Nuclear Station Database AMR Query," list individual components of the system including expansion joint (engine exhaust), filters (body only), flexible coupling, flexible hose heat exchangers (channel head), heat exchangers (shell), heat exchangers (tubes), heat exchangers (tubesheet), heaters (body only), mufflers, orifices, pipe and fittings, pumps (casing only), reservoir (air), reservoir (rocker), sight glass (body only), silencers, strainers (body only), tanks, tube and tube fittings, turbocharger (casing only), and valves (body only).

An internal environment of alternating wet-dry, air-gas causes the aging effect of loss of material from corrosive impacts in carbon steel components.

An internal environment of raw water causes the aging effects of loss of material from crevice and pitting corrosion, MIC, and erosion, and heat exchanger fouling from biological materials and particulates in stainless steel and brass components.

An internal environment of treated water causes the aging effect of loss of material from crevice and pitting corrosion and cracking from SCC in carbon steel, stainless steel, and brass components. For carbon steel components, the internal environment of treated water causes the aging effect of loss of material from galvanic corrosion and general corrosion. An internal environment of treated water causes the aging effect of loss of material from erosion or erosion-corrosion for brass and stainless steel. The same internal environment of treated water causes the aging effect of heat exchanger fouling due to particulates for brass components. An internal environment of treated water also causes the aging effect of loss of material from crevice corrosion, erosion-corrosion, galvanic corrosion, and pitting corrosion in copper components.

An internal environment of fuel oil causes the aging effect of loss of material from MIC for copper, brass, and carbon steel components. For carbon steel components, an internal environment of fuel oil also causes the aging effect of loss of material due to crevice and pitting corrosion, galvanic corrosion, and general corrosion. No aging effect is identified for any components exposed to an internal environment of dry air-gas.

Loss of material is identified as aging effect from MIC, crevice and pitting corrosion, galvanic corrosion, and general corrosion for carbon steel components exposed to an underground environment. Loss of material is identified as an aging effect from general and galvanic corrosion for carbon steel and cast iron components exposed to a sheltered environment. No aging effect is identified for stainless steel, brass, aluminum, and copper components exposed to a sheltered environment. Loss of material is identified as an aging effect from general and galvanic corrosion for carbon steel components exposed to a yard environment.

Cracking is identified as an aging effect from radiation and thermal embrittlement for rubber components exposed to a sheltered environment.

No aging effect is identified for rubber components exposed to fuel oil or treated water environments.

No aging effect is identified for aluminum components in either an air-gas or a sheltered environment. No aging effect is identified for ductile iron components in an oil environment. Loss of material due to general corrosion is identified as an aging effect for ductile components in a sheltered environment.

Aging Management Programs:

The following AMPs are utilized to manage aging effects in the diesel generator service systems:

1.2 Inspections for Mechanical Components Program (B.2.11)

- Diesel Generator Systems Inspection Program (B.2.2)
– Chemistry program Program (B.1.4)
5. Service Water System Reliability and In-Service Test Program (B.1.9)
- Buried piping and Tanks Inspection Program (B.2.10)
- Heat Exchanger Inspections Program (B.2.12)

A description of the AMPs is provided in Appendix B of the LRA. The applicant indicated that the effects of aging associated with the components of the diesel generator service systems will be adequately managed by the AMPs during the period of extended operation.

<u>Staff Evaluation</u>

Aging Effects:

The staff reviewed the information in Section 2.3.3.7 and Tables 2.3-23, 3.3-1, and 3.3-2 in the LRA, as well as in the tables entitled, "Virgil C. Summer Nuclear Station Database AMR Query" and "Virgil C. Summer Nuclear Station Database AMR Query Notes," in the supplement. During its review, the staff determined that additional information was needed.

Numerous tables included in the application list the component material and environment to which the component is exposed. However, the applicant did not provide a description of these environments in the LRA. By letter dated March 28, 2003, the staff issued RAI 3.3-1, pertaining to this issue of the plant specific characteristics of the environment. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.1 of this SER and is characterized as resolved.

The applicant identified the flexible coupling in the diesel generator service systems as subject to AMR. The applicant stated that component/component type AMR results for VCSNS are consistent with NUREG-1801 in material and environment, and partially consistent in aging effects. The VCSNS plant-specific program credited for managing aging effects is B.2.11, Inspections for Mechanical Components Program. This AMP inspects component external surfaces for signs of degradation.

In the GALL Report, elastomer-based components in warm, moist air have the aging effects of hardening, cracking, and loss of strength due to elastomer degradation. The associated AMP is plant-specific. In the VCSNS LRA (Table 3.3-1), elastomer-based components in an air or gas (indoor) environment have the aging effects of hardening, cracking, and loss of strength due to elastomer degradation and the AMP credited is B.2.11, "Inspections for Mechanical Components Program."

For flexible hose and flexible couplings included in LRA Table 2.3-23, the applicant identified Table 3.3-1, Item 2, and Table 3.3-2, Item 26. LRA Table 3.3-1, Item 2 states that loss of material due to wear is not considered an aging effect because mechanical components must perform their license renewal intended functions without moving parts. Wear that occurs on nonmoving components is considered to be caused by improper design and should be corrected by normal maintenance activities. The staff disagrees with the applicant's explanation that wear is caused by improper design in the nonmoving components. The staff believes that wear of elastomer may be attributed to many conditions, such as relative movement due to thermal expansion. By letter dated March 28, 2003, the staff requested, in

RAI 3.3.2.4.7-1, the applicant to provide the technical basis to justify why the aging effect of loss of material due to wear is not applicable.

LRA Table 3.3-2, Item 26 states that internal surfaces of rubber components are not considered to be susceptible to degradation in fluid environments due to lack of excessive temperatures and to the change in material properties of elastomers being closely tied to external conditions, such as ultraviolet radiation. Therefore, no aging management is required. In the same RAI 3.3.2.4.7-1, the staff requested the applicant to clarify what type of rubber is used and to provide technical justification and operational history to demonstrate that the internal surfaces for flexible hoses and other elastomers used in diesel generator services systems do not have aging effects of hardening, cracking, loss of strength, and wear from exposure to the process fluid.

In its response by letter dated June 12, 2003, the applicant stated that VCSNS maintains that wear is not an aging effect and included the following basis. The diesel generators are normally in standby for emergency use and are usually only started on a monthly frequency for routine surveillance. Because of the "keep-warm" systems for the lube oil and jacket water systems in the diesel, elastomers in these diesel generator systems will not experience extremes in temperatures; therefore, VCSNS considers that flexing of an elastomer due to thermal expansion does not contribute to any significant degradation. However, VCSNS will manage cracking due to radiation and thermal embrittlement through the Inspections for Mechanical Components Program which will detect any significant degradation.

The applicant further stated that the material/environment combination for the elastomer components in the diesel generator services system include rubber/lube oil, rubber/treated water, and neoprene/air-gas. The rubber is Buna N rubber. According to Table 5-15 of "Corrosion Engineering," Third Edition, Buna N rubber exhibits excellent resistance to oil and good resistance to water absorption, but poor resistance to sunlight aging. Therefore, external surfaces would show age-related degradation before the internal surfaces. The neoprene conforms to ASTM SC 610AF. The neoprene component is in the inlet air piping, which is the same environment as ambient air; therefore, external surface conditions would be indicative of internal conditions. Thus, the applicant maintains that the Inspections for Mechanical Components Program will adequately manage aging of these components during the period of extended operation.

By letter dated July 29, 2003, the staff questioned if the internal environment for the flexible neoprene hose may be more severe than the ambient environment of the diesel generator building. The staff requested the applicant to clarify why the external surface conditions would be indicative of internal conditions since external surfaces are exposed to ambient conditions in the building which may not be equivalent to the exposure of internal surfaces to inlet air conditions from out of doors.

In the response dated September 2, 2003, the applicant stated that the neoprene component is in the inlet air piping, which is essentially the same environment as ambient air. The ventilation for the diesel generator rooms is supplied from outside air. It is neither conditioned nor filtered. The inlet air that is supplied through the neoprene components is also supplied from outside air, but is filtered. The applicant further stated that the diesel generators are normally in standby for emergency use and are started on a monthly frequency for routine surveillance. For the vast majority of the time, the internal environment for these neoprene components is stagnant,

filtered, ambient air; therefore, internal conditions would be no harsher than the external conditions. External surface conditions of the neoprene components would be indicative of internal conditions. Thus, VCSNS maintained that the Inspections for Mechanical Components Program will adequately manage aging of these components during the period of extended operation.

On the basis of its review, the staff finds the applicant's initial response, together with the applicant's response to the staff's comment, acceptable because (1) the applicant has properly identified that because of the "keep-warm" systems for the lube oil and jacket water systems in the diesel, elastomers in these diesel generator systems will not experience extremes in temperatures and flexing of an elastomer due to thermal expansion does not contribute to any significant degradation (2) the applicant has clarified the type of rubber used and has demonstrated that the Inspections for Mechanical Components Program will adequately manage aging of these components during the period of extended operation and (3) the applicant has properly identified that, for the majority of the time, the internal conditions would be no harsher than the external conditions and that external surface conditions of the neoprene components would, in general, be indicative of internal conditions. All issues in RAI 3.3.2.4.7-1, are considered resolved.

No AMP has been identified for managing loss of material due to galvanic corrosion for any applicable components in the diesel generator service systems. By letter dated March 28, 2003, the staff requested, in RAI 3.3.2.4.7-2, the applicant to provide the basis for not including such an AMP.

In its response by letter dated June 12, 2003, the applicant stated that several programs manage galvanic corrosion for various material/environment combinations in the diesel generator service systems. These programs are the Chemistry Program, the Inspections for Mechanical Components Program, the Buried Piping and Tanks Inspections Program, and the Service Water System Reliability and In-Service Testing Program.

However, the staff identified that the likelihood and extent of galvanic corrosion depends on the contact between different metals or alloys with relative separation of the contacting metal/alloys on the galvanic potential chart, the electrolyte, immersion time, and geometrical factors. Many of these factors are location-dependent. By letter dated July, 2003, the staff requested the applicant to clarify whether, in using these AMPs to manage the galvanic corrosion, the inspections are to be performed in areas with the highest likelihood of galvanic corrosion or are to be performed on an opportunistic basis. The staff requested the applicant to provide justifications for either case.

By letter dated September 2, 2003, the applicant stated that the Chemistry Program manages galvanic corrosion for components in the treated water and fuel oil portions of the diesel generator systems by maintaining high purity, thereby inhibiting the conductivity of the electrolyte necessary for galvanic reactions. The applicant further stated that, although galvanic corrosion normally does not occur in the absence of a completely wetted environment, the inspections for mechanical components will manage galvanic corrosion for external surfaces of components by periodic inspections for any surface abnormalities.

The applicant stated that the underground portions of the diesel generator systems (fuel oil) are entirely carbon steel, therefore, there will be no galvanic reaction between components. The

only possible galvanic reaction would be between the buried components and the surrounding soil; therefore, the buried components would all be equally susceptible. The Buried Piping and Tanks Inspections Program manages galvanic corrosion for the underground portions of the diesel generator systems through inspections performed on an opportunistic basis. Operating experience for the diesel generator fuel oil storage tanks has shown negligible wall thinning.

Further, the applicant stated that the service water system cools the diesel generator heat exchangers and the Service Water System Reliability and In-Service Testing Program will manage galvanic corrosion of the service water side of these heat exchangers. The Service Water System Reliability and In-Service Testing Program is the equivalent of the GALL Open-Cycle Cooling Water System Program.

On the basis of its review, the staff finds the applicant's initial response, together with the applicant's response to the staff's comment, acceptable because (1) the applicant has properly identified that the Chemistry Program, the Inspections for Mechanical Components Program, the Buried Piping and Tanks Inspections Program, and the Service Water System Reliability and In-Service Testing Program manage galvanic corrosion for various material/environment combinations in the diesel generator service systems, and (2) the applicant has properly identified the specific ways in which these AMPs are used to manage the loss of materials due to galvanic corrosion. The staff further identified that the operating experience, as stated in the VCSNS LRA B.2.10, "Buried Piping and Tanks Inspections," indicates that an ultrasonic examination of the fuel oil storage tanks and associated piping was performed. Each tank was inspected at 102 locations, evenly distributed over the entire surface area, and no significant corrosion or age-related degradation was found. All issues in RAI 3.3.2.4.7-2 are considered resolved.

LRA Table 3.3-2, Item 10 indicates that exhaust piping and mufflers are thick-walled components and do not require aging management. The corrosion of carbon steel components exposed to condensation and alternate wetting and drying, such as the mufflers and piping used in the diesel exhaust, is affected by their orientation and the proper function of any installed drain traps. By letter dated March 28, 2003, the staff requested in RAI 3.3.2.4.7-3, the applicant to address the issue of whether the exhaust contains any corrosive contaminants, such as sulfur, that may be corrosive to the material. The applicant was also asked to provide the basis for not inspecting the interiors of silencers/mufflers and exhaust piping for localized corrosion from sulfuric acid and condensation.

By letter dated June 12, 2003, the applicant stated that the mufflers and muffler exhaust piping contain drain traps. The Diesel Generator Systems Inspections Program already includes carbon steel expansion joints exposed to engine exhaust as components to be inspected. The applicant further stated that the scope of the program will be revised to include the mufflers and exhaust piping. The staff finds the applicant's response to RAI 3.3.2.4.7-3, acceptable because the applicant has committed to revise the scope of the program to include the mufflers and exhaust piping.

On the basis of its review of the information provided in the LRA and the additional information included in the applicant's response to the above RAIs, the staff finds that the aging effects that result from contact of the diesel generator service systems SSCs to the environments described in LRA Tables 2.3-23, 3.3-1, and 3.3-2 are consistent with industry experience for these combinations of materials and environments. Therefore, the staff finds that the applicant

has identified the appropriate aging effects for the materials and environments associated with the components in the diesel generator service systems.Aging Management Programs

The applicant credits the following AMPs for managing the aging effects in the diesel generator service systems:

- Inspections for Mechanical Components Program (3.0.3.7)
- Diesel Generator Systems Inspection Program (3.3.2.3.4)
- Chemistry Program (3.0.3.2)
- Service Water System Reliability and In-Service Test Program (3.3.2.3.1)
- Buried Piping and Tanks Inspection Program (3.0.3.6)
- Heat Exchanger Inspections Program (3.0.3.8)

The Inspections for Mechanical Components Program, Chemistry Program, Buried Piping and Tanks Inspection Program, and Heat Exchanger Inspections Program are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Sections 3.0.3.7, 3.0.3.2, 3.0.3.6, and 3.0.3.8, respectively, of this SER. The use of one-time inspections for the verification of the effectiveness of the Chemistry Program is also evaluated and documented in Section 3.0.3.2 of this SER.

The staff has evaluated the system-specific AMPs Service Water System Reliability and In-Service Testing Program, and the Diesel Generator Systems Inspection Program and has found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Sections 3.3.2.3.1 and 3.3.2.3.4, respectively, of this SER.

After evaluating the applicant's AMR for each of the components in the diesel generator service systems, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects for this system. For those components identified in Table 3.3-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.3-2, the staff verified that the applicant credited AMPs that are appropriate for the identified aging effects.

On the basis of its review, the staff finds that the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with the diesel generator service systems. In addition, the staff finds the associated program descriptions in the FSAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

Conclusions

On the basis of its review and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement

for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.3.2.4.8 Fire Service System

Summary of Technical Information in the Application

The description of the fire service system can be found in Section 2.3.3.8 of this SER. The passive, long-lived components of this system that are subject to an AMR are identified in LRA Table 2.3-24. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1 and 3.3-2. FSAR Section 9.5.1, “Fire Protection System,” provides additional information concerning the interior/exterior fire protection system.

Aging Effects:

LRA Table 2.3-24 lists individual system components that are within the scope of license renewal and subject to an AMR. These components include bolting, piping, tubing, fittings, valves, nozzles, fire hydrant and pump casings, components in the water-based fire suppression system, components in the CO_2 fire suppression system, components in the diesel fire system, doors, barrier penetration seals, and concrete structures (fire barrier walls, ceilings, and floors).

The LRA identified that carbon steel, galvanized steel, cast iron, and copper in air are subject to loss of material due to general external corrosion, and carbon steel and low-alloy steel in dripping boric acid are subject to loss of material due to boric acid corrosion. The LRA also identifies that stainless steel in treated water is subject to loss of material due to crevice and pitting corrosion and cracking due to SCC. The LRA identifies that components in water-based fire suppression systems are subject to loss of material due to general pitting, crevice, and galvanic corrosion, MIC, and biofouling. Fire barriers, walls, ceilings, floors, doors, and penetration seals are subject to loss of material due to water, hardening, and shrinkage caused by to weathering, concrete cracking, and spalling from to freeze thaw, aggressive chemical attack, and reaction with aggregates, and loss of material due to corrosion of embedded steel. Stainless steel in oil (reactor coolant pump oil collection system) is subject to loss of material due to galvanic, general, pitting, and crevice corrosion. Buried piping and fittings are subject to loss of material due to general, pitting, and crevice corrosion and MIC.

Aging Management Programs:

The following AMPs are utilized to manage aging effects in the fire service system:

- Boric Acid Corrosion Surveillances Program (B.1.2)
- Fire Protection Program (B.1.5)
- Selective Leaching of Materials Program (B.1.5)
- Flow-Accelerated Corrosion Monitoring Program (B.1.6)
- Structures Monitoring Program (B.1.18)
- Buried Piping and Tanks Inspection Program (B.2.10)

A description of these AMPs is provided in LRA Appendix B. The applicant indicated that the effects of aging associated with the components of the fire protection system will be adequately managed by these AMPs during the period of extended operation.

Staff Evaluation

The staff reviewed the applicant's fire protection system in the LRA to determine whether the applicant had demonstrated that the effects of aging for the fire protection system will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff's review was conducted in accordance with Section 3.3 of the SRP-LR (NUREG-1800) and is described below.

Aging Effects:

The staff reviewed the information in LRA Tables 2.3.24, 3.3-1, and 3.3-2 for the fire protection system. During its review, the staff determined that additional information was needed. By letter dated March 28, 2003, in RAI 3.3.2.4.8-1(1), pertaining to the one-time inspection of the components in the reactor coolant pump oil collection system, the staff questioned why these components should not be inspected periodically for managing aging.

In its response dated June 12, 2003, the applicant stated that NUREG-1801 recommends a one-time inspection for the components of the reactor coolant pump oil collection system that are composed of carbon steel, copper, and brass. The reactor coolant pump oil collection system components at the plant are composed of stainless steel. The staff finds this response reasonable and acceptable since none of the component types of the reactor coolant pump oil collection system will collect water in low spots, all are subject to high ambient condition which would cause evaporation of any moisture minimizing corrosion.

In RAI 3.3.2.4.8-1(2), the staff asked why Item 18 of LRA Table 3.3-2 does not identify any aging effects or mechanism to be evaluated for the fire service system nozzles, piping, and fire hydrants.

In its response dated June 12, 2003, the applicant stated that LRA Table 3.3-2 concerns auxiliary system components identified in NUREG-1801. Item 18 of this table addresses components that are normally in a standby mode where air is the predominant internal environment. The plant's external environments for these components are addressed in LRA Table 3.3.1, Items 5 and 20. The staff reviewed Item 20 of LRA Table 3.3-1 which addresses the AMPs for components in the water-based fire protection system. Therefore, the staff finds the applicant's response acceptable.

On the basis of its review of the information provided in the LRA and the additional information in the applicant's response to the staff's RAIs, the staff finds that the aging effects identified for the fire protection system components described in LRA Tables 2.3.24, 3.3-1, and 3.3-2 are consistent with industry experience for these combinations of materials and environments. Therefore, the staff finds that the applicant has identified the appropriate aging effects for the materials and environments associated with the components in the fire protection system.

Aging Management Programs:

The applicant credited the following AMPs for managing the aging effects in the fire service systems:

- Boric Acid Corrosion Surveillances Program (B.1.2)
- Fire Protection Program (B.1.5)
- Selective Leaching of Materials Program (B.1.5)
- Flow-Accelerated Corrosion Monitoring Program (B.1.6)
- Structures Monitoring Program (B.1.18)
- Buried Piping and Tanks Inspections Program (B.2.10)

These AMPs are credited for managing the aging effects of components in several structures and systems that are considered as common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the effects of the components in several structures and systems and, therefore, are considered common AMPs.

On the basis of its review of the information provided in the LRA, the staff concluded that the above identified AMPs will effectively manage the aging effects of the fire protection system.

On the basis of its review, the staff finds that the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with fire protection system.

Conclusion

On the basis of its review and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.3.2.4.9 Fuel Handling System

Summary of Technical Information in the Application

The description of the fuel handling system can be found in Section 2.3.3.9 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3-25. The components, aging effects, and AMPs are provided in LRA Table 3.3-2.

Aging Effects:

Components of the fuel handling system are described in Section 2.3.3.9 of the LRA as being within the scope of license renewal and subject to an AMR. Tables 2.3-25 and 3.3-2 of the LRA, and the table entitled, "Virgil C. Summer Nuclear Station Database AMR Query," in the supplement lists the system component which consists of fuel and transfer tubes.

The applicant identified no aging effects for the stainless steel and carbon steel components that are embedded in concrete. In addition, the applicant identified no aging effects for the stainless steel exposed to a sheltered or ventilation environment.

Aging Management Programs:

The applicant identified no aging effects for the components of the fuel handling system. Therefore, no AMPs are required for this system.

Staff Evaluation

Aging Effects:

The staff reviewed the information in Section 2.3.3.9 and Tables 2.3-25, 3.3-1, and 3.3-2 in the LRA, as well as in the tables entitled, "Virgil C. Summer Nuclear Station Database AMR Query," and "Virgil C. Summer Nuclear Station Database AMR Query Notes," in the supplement. During its review, the staff determined that additional information was needed.

Numerous tables included in the application list the component material and environment to which the component is exposed. However, the applicant did not provide a description of these environments in the LRA. By letter dated March 28, 2003, the staff issued RAI 3.3-1, pertaining to this issue of the plant-specific characteristics of the environment. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.1 of this SER and is characterized as resolved.

On the basis of its review of the information provided in the LRA, the staff finds that the absence of aging effects that result from contact of the fuel handling system SSCs to the environments described in Tables 2.3-23, 3.3-1, and 3.3-2 is consistent with industry experience for these combinations of materials and environments and is, therefore, acceptable.

Aging Management Programs:

Based on the review of the information provided in the LRA, the staff concurs with the applicant's conclusion that no AMPs are required for the fuel handling system because there are no applicable aging effects for the components of this system.

Conclusions

On the basis of its review, the staff concludes that the applicant has justified that no AMPs are required because there are no applicable aging effects for components in the fuel handling system. In addition, there is reasonable assurance that the component intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.4.10 Gaseous Waste Processing System

Summary of Technical Information in the Application

The description of the gaseous waste processing system can be found in Section 2.3.3.10 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3-26. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1 and 3.3-2.

Aging Effects:

Components of the gaseous waste processing system are described in Section 2.3.3.10 of the LRA as being within the scope of license renewal and subject to an AMR. Tables 2.3-26, 3.3-1, and 3.3-2 of the LRA, and the table entitled, "Virgil C. Summer Nuclear Station Database AMR Query," in the supplement list individual components of the system, including heat exchanger shells, heat exchanger spiral baffles, heat exchanger tube coils, heat exchanger tube manifolds, heat exchanger channel heads, heat exchanger tubes, heat exchanger tubesheets, pipe and fittings, tube and tube fittings, and valve bodies.

Carbon steel components are subject to the aging effects of loss of material of internal surfaces from exposure to a treated water environment due to crevice corrosion, galvanic corrosion, general corrosion, and pitting corrosion. External surfaces of carbon steel are also subject to an aging effect of loss of material due to boric acid corrosion from exposure to a sheltered environment. Internal surfaces of stainless steel components are subject to the aging effects of loss of material from crevice and pitting corrosion and cracking from SCC due to exposure to a treated water environment. Internal or external surfaces of stainless steel components are also subject to the aging effect of cracking from SCC due to exposure to an air-gas environment at temperatures greater than 200 °F. Exposure of internal or external surfaces of stainless steel components to a sheltered environment or an air-gas environment at temperatures less than 200 °F has no aging effect.

Aging Management Programs:

The following AMPs are utilized to manage aging effects in the gaseous waste processing system:

- Chemistry Program (B.1.4)
- Inspections for Mechanical Components Program (B.2.11)
- Boric Acid Corrosion Surveillances Program (B.1.2)
- Waste Gas System Inspection Program (B.2.8)
- Maintenance Rule Structures Program (B.1.18)

A description of these AMPs is provided in Appendix B of the LRA. The applicant indicated that the effects of aging associated with the components of the gaseous waste processing system will be adequately managed by these AMPs during the period of extended operation.

Staff Evaluation

Aging Effects:

The staff reviewed the information in Section 2.3.3.10 and Tables 2.3-26, 3.3-1, and 3.3-2 in the LRA, as well as in the tables entitled, "Virgil C. Summer Nuclear Station Database AMR Query,"

and "Virgil C. Summer Nuclear Station Database AMR Query Notes," in the supplement. During its review, the staff determined that additional information was needed.

Numerous tables included in the application list the component material and environment to which the component is exposed. However, the applicant did not provide a description of these environments in the LRA. By letter dated March 28, 2003, the staff issued RAI 3.3-1, pertaining to this issue of the plant-specific characteristics of the environment. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.1 of this SER and is characterized as resolved.

A common RAI (RAI 3.3-2) concerning aging mechanisms related to the aging effect of loss of material in a sheltered environment for carbon steel components in the auxiliary systems is related to components in the gaseous waste processing system. This issue is evaluated in Section 3.3.2.5.2 of this SER.

On the basis of its review of the information provided in the LRA and the additional information included in the applicant's response to the above RAIs, the staff finds that the aging effects that result from contact of the gaseous waste processing system SSCs to the environments described in Tables 2.3-9, 3.3-1, and 3.3-2 are consistent with industry experience for these combinations of materials and environments. Therefore, the staff finds that the applicant has identified the appropriate aging effects for the materials and environments associated with the components in the gaseous waste processing system

Aging Management Program:

The applicant credited the following AMPs for managing the aging effects in the gaseous waste processing systems:

- Chemistry Program (3.0.3.2)
- Boric Acid Corrosion Surveillances Program (3.0.3.1)
- Waste Gas System Inspection Program (3.3.2.3.8)
- Inspections for Mechanical Components Program (3.0.3.7)
- Maintenance Rule Structures Program (3.0.3.4)

The Chemistry Program, Boric Acid Corrosion Surveillances Program, Inspections for Mechanical Components Program, and Maintenance Rule Structures Program are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Sections 3.0.3.2, 3.0.3.1, 3.0.3.7, and 3.0.3.4, respectively, of the SER.

The staff has evaluated the system-specific Waste Gas System Inspection AMP, and has found it to be acceptable for managing the aging effects identified for this system. The staff's evaluation of this AMP is documented in Section 3.3.2.3.8 of this SER.

After evaluating the applicant's AMR for each of the components in the gaseous waste processing system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects for this system. For those components

identified in Table 3.3-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.3-2, the staff verified that the applicant credited AMPs that are appropriate for the identified aging effects.

On the basis of its review, the staff finds that the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with the gaseous waste processing system. In addition, the staff finds the associated program descriptions in the FSAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

Conclusions

On the basis of its review and audit of the applicant’s program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.3.2.4.11 Industrial Cooler System

As described in Section 2.3.3.11 of the LRA, the applicant’s scoping and screening review concluded that there are no mechanical components/component types required for the industrial cooler system to perform its system intended function; therefore, no AMR is required. The staff’s evaluation of the scoping and screening process is documented in Section 2.3.3.11 of this SER.

3.3.2.4.12 Instrument Air Supply System

Summary of Technical Information in the Application

The description of the instrument air supply system can be found in Section 2.3.3.12 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3-27. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1 and 3.3-2.

Aging Effects:

Components of the instrument air supply system are described in Section 2.3.3.12 of the LRA as being within the scope of license renewal and subject to AMR. Tables 2.3-27, 3.3-1, and 3.3-2 of the LRA, and the supplementary table and notes entitled, "Virgil C. Summer Nuclear Station Database AMR Query,” list individual components of the system including pipe, tanks, tube and tube fittings, and valves (bodies only).

Loss of material due to general corrosion is identified as an aging effect for carbon steel components exposed to an internal environment of moisture air-gas. No aging effect is identified for stainless steel, aluminum, brass, and cast iron components exposed to an internal environment of dry air-gas. Loss of material due to boric acid attack is identified as an aging

effect for carbon steel, aluminum, brass, and cast iron components exposed to an external environment of the reactor building or a sheltered environment. Loss of material due to MIC is identified as an aging effect for stainless steel components exposed to an external environment or sheltered environment.

Aging Management Programs:

The following AMPs are utilized to manage aging effects in the instrument air supply system:

- Maintenance Rule Structures Program (B.1.18)
- Boric Acid Corrosion Surveillances Program(B.1.2)
- Service Air Systems Inspection Program (B.2.6)

A description of the AMPs is provided in Appendix B of the LRA. The applicant indicated that the effects of aging associated with the components of the instrument air supply system will be adequately managed by the AMPs identified during the period of extended operation.

<u>Staff Evaluation</u>

Aging Effects:

The staff reviewed the information in Section 2.3.3.12 and Tables 2.3-27, 3.3-1, and 3.3-2 in the LRA as well as in the supplementary table and notes entitled, "Virgil C. Summer Nuclear Station Database AMR Query." During its review, the staff determined that additional information was needed.

Numerous tables included in the application list the component material and environment to which the component is exposed. However, the applicant did not provide a description of these environments in the LRA. By letter dated March 28, 2003, the staff issued RAI 3.3-1, pertaining to this issue of the plant-specific characteristics of the environment. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.1 of this SER and is characterized as resolved.

For the AMR of several components within the license renewal evaluation boundary of the instrument air supply system, the applicant stated that these components are exposed to an oil-free, filtered, and dried compressed air (referred to as an air-gas environment), and loss of material is not an aging effect requiring management during the period of extended operation. It should be noted that in the instrument air supply system, components that are located upstream of the air dryers are generally exposed to a wet air-gas environment and, therefore, may be subject to loss of material due to general and pitting corrosion. In addition, it is reasonable to assume that components downstream of the dryers are exposed to a dry air-gas environment. However, this may not be supported by operating experience. For example, NRC IN 87-28, "Air Systems Problems at U.S. Light Water Reactors," states the following, "A loss of decay heat removal and significant primary system heat up at Palisades in 1978 and 1981 were caused by water in the air system." This experience implies that the air-gas system downstream of the dryer may not be dry. On the basis of this industry experience, by letter dated March 28, 2003, the staff requested, in RAI 3.3.2.4.12-1, the applicant to discuss its plant-specific operating experience related to components that are exposed to an instrument air

environment, and to provide a technical basis for not identifying loss of material as an aging effect for these components.

In its response dated June 12, 2003, the applicant stated that NRC GL 88-14 addressed the concerns of NRC IN 87-28. VCSNS responses to the recommendations of GL 88-14 resolved concerns for the quality of air supplied to safety-related equipment. These responses can be found in a letter from O.S. Bradham to the Document Control Desk, NRC, dated February 2, 1989, "Response to Generic Letter 88-14."

The applicant further stated that there are various carbon steel components of air systems that experience an ambient, moist air environment that are in scope for license renewal. The Service Air Systems Inspection Program manages the aging of these components. The Service Air System Inspection Program concerns those components that are not pertinent to the quality of air supplied to safety-related equipment and, therefore, are not pertinent to the concerns of NRC GL 88-14. These components concern the pressure boundary function of specific containment penetrations, containment hatch testing, and emergency air supply to the personnel hatches. Finally, the applicant stated that ambient moist air (not dried by an air dryer) is assumed to be the internal environment for these components.

On the basis of its review, the staff finds the applicant's response acceptable because the applicant has provided a reasonable technical basis for not identifying loss of material as an aging effect for these components. All issues associated with RAI 3.3.2.4.12-1 are considered resolved.

On the basis of its review of the information provided in the LRA and the additional information included in the applicant's response to the above RAI, the staff finds that the aging effects that result from contact of the instrument air supply system SSCs to the environments described in Tables 2.3-27, 3.3-1, and 3.3-2 are consistent with industry experience for these combinations of materials and environments. Therefore, the staff finds that the applicant has identified the appropriate aging effects for the materials and environments associated with the components in the instrument air supply system.

Aging Management Programs:

The applicant credited the following AMPs for managing the aging effects in the instrument air supply system:

- Maintenance Rule Structures Program (3.0.3.4)
- Boric Acid Corrosion Surveillances Program (3.0.3.1)
- Service Air Systems Inspection Program (3.3.2.3.7)

The Maintenance Rule Structures Program and the Boric Acid Corrosion Surveillances Program are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Sections 3.0.3.4 and 3.0.3.1, respectively, of this SER.

The staff has evaluated the system-specific Service Air Systems Inspection AMP and has found it to be acceptable for managing the aging effects identified for this system. The staff's evaluation of this AMP is documented in Section 3.3.2.3.7 of this SER.

After evaluating the applicant's AMR for each of the components in the instrument air supply system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects for this system. For those components identified in Table 3.3-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.3-2 , the staff verified that the applicant credited AMPs that are appropriate for the identified aging effects.

On the basis of its review, the staff finds that the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with the instrument air supply system. In addition, the staff finds the associated program descriptions in the FSAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

Conclusions

On the basis of its review and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.3.2.4.13 Leak Detection System

As described in Section 2.3.3.13 of the LRA, the applicant's scoping and screening review concluded that the portion of the leak detection system that is in scope for license renewal contains active, nonpressure boundary components; therefore, no AMR is required.

3.3.2.4.14 Liquid Waste Processing System

Summary of Technical Information in the Application

The description of the liquid waste processing system can be found in Section 2.3.3.14 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3-28. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1 and 3.3-2.

Aging Effects:

Components in the liquid waste processing system are described in Section 2.3.3.14 of the LRA as being within the scope of license renewal and subject to an AMR. Tables 2.3-28, 3.3-1, and 3.3-2 of the LRA and the Virgil C. Summer Nuclear Station Database AMR Query Table in the LRA supplement documents list individual components of the system.

The component groups in this category in the liquid waste processing system listed by the applicant in the VCSNS LRA include condensers (XEV0029-CN1, XEV0029-CN2), waste evaporator—channel heads; waste evaporator—tubes; waste evaporator—tubesheets; waste evaporator—shell; heat exchanger (XEV0029-HE2), waste evaporator—shell; heat exchanger (XHE0012), RC drain tank—shell; heat exchanger (XHE0022), waste evaporate concentrates sample—shell; RC drain tank—tubes; RC drain tank—tubesheet; waste evaporate concentrates sample—manifolds; heat exchanger (XHE0022), waste evaporate concentrates sample—tubes; valves (body only); and pipe and fittings.

Stainless steel components exposed to borated water are subject to the aging effects of loss of material and cracking due to crevice corrosion, pitting corrosion, and SCC. Stainless steel and carbon steel components exposed to a sheltered environment are subject to the aging effect of loss of material due to MIC. Carbon steel components exposed to a reactor building environment are subject to the aging effect of loss of material due to boric acid corrosion. Stainless steel and carbon steel components exposed to treated water are subject to the aging effects of loss of material and cracking due to crevice, galvanic, general, and pitting corrosion, and SCC. No aging effects are identified for stainless steel components exposed to air-gas, reactor building, and ventilation environments. Carbon steel components exposed to air-gas are identified as having no aging effects.

Aging Management Programs:

The following AMPs are credited to manage the aging effects in the liquid waste processing system:

- Boric Acid Corrosion Surveillances Program (B.1.2)
- Chemistry Program (B.1.4)
- Maintenance Rule Structures Program (B.1.18)
- Liquid Waste System Inspection Program (B.2.3)

A description of these AMPs is provided in Appendix B of the LRA. The applicant indicated that the effects of aging associated with the components of the liquid waste processing system will be adequately managed by these AMPs during the period of extended operation.

<u>Staff Evaluation</u>

Aging Effects:

The staff reviewed the information identified by the applicant for the components exposed to the liquid waste processing system environments as described in Section 2.3.3.14, Tables 2.3-28, 3.3-,1 and 3.3-2 of the LRA, as well as in the tables entitled, "Virgil C. Summer Nuclear Station Database AMR Query," and "Virgil C. Summer Nuclear Station Database AMR Query Notes," in the LRA supplement documents. During its review, the staff determined that additional information was needed.

Numerous tables included in the application list the component material and environment to which the component is exposed. However, the applicant did not provide a description of these environments in the LRA. By letter dated March 28, 2003, the staff issued RAI 3.3-1, pertaining to this issue of the plant-specific characteristics of the environment. The staff's

evaluation of the applicant's response is documented in Section 3.3.2.5.1 of this SER and is characterized as resolved.

By letter dated March 28, 2003, the staff issued RAI 3.3-3, pertaining to this issue of the susceptibility to aging effects for stainless steel components in an ambient environment. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.3 of this SER and is characterized as resolved.

In the LRA Table 3.3-1, Item 14 and the table entitled, "Virgil C. Summer Nuclear Station Database Query," the applicant identified the aging effects on carbon steel and stainless steel heat exchanger/condenser components in the liquid waste processing system that are exposed to treated water and the corresponding AMP. The applicant further stated that the AMR results for this group are consistent with GALL (VII.C2.2-a, C2.2.1) in material, environment, and aging effects. The applicant also stated that the Chemistry Program is considered to provide adequate management in lieu of the Closed-Cycle Cooling Water System Program that is recommended for this group by GALL. It should be noted that the AMP, "Closed-Cycle Cooling Water System Program," includes preventive measures, as well as surveillance testing and inspection. By letter dated March 28, 2003, the staff requested, in RAI 3.3.2.4.14-1, the applicant to explain how the Chemistry Program alone (without one-time inspection to verify the effectiveness of the Chemistry Program) is considered to provide adequate management of the identified aging effects for these components.

In its response dated June 12, 2003, the applicant stated that the heat exchanger/condenser components of the liquid waste processing system are in scope for license renewal because they constitute a pressure boundary with the component cooling water system. The two internal water environments for the in-scope liquid waste processing system components are reactor grade, recyclable, borated water, and treated water. The Liquid Waste Systems Inspections Program will manage aging of stainless steel components of the liquid waste processing system exposed to borated water. The applicant further stated that the Chemistry Program will manage aging of the stainless steel and carbon steel components of the liquid waste processing system exposed to treated water. The Chemistry Program has proven effective at managing aging degradation in the component cooling water system, as evidenced by the review of operating history in response to GL 89-13. Finally, the applicant stated that prior to the period of extended operation, one-time inspections will be conducted in low-flow areas of various treated water systems to demonstrate the effectiveness of the Chemistry Program.

On the basis of its review, the staff finds the applicant's response acceptable because the applicant has committed to conduct one-time inspections in low-flow areas of various treated water systems to demonstrate the effectiveness of the Chemistry Program prior to the period of extended operation.

The GALL Report identifies SCC aging effects for stainless steel components exposed to treated water, and corresponding AMPs, and recommends further evaluations. In the table entitled, "Virgil C. Summer Nuclear Station Database Query," the applicant stated that the aging effects for the combination of those components/component types and environments are consistent with GALL. However, the applicant also stated that further evaluations were not recommended by GALL. By letter dated March 28, 2003, the staff requested, in RAI 3.3.2.4.14-2, the applicant to explain why the conclusion in the LRA is different from the GALL Report.

In its response dated June 12, 2003, the applicant stated that all of the columns of Table 3.3-1 of the LRA, except for the last column, are NUREG-1801 listings. The last column is the VCSNS response. NUREG-1801 states that, for this AMR item, if there were an adequate "closed-cycle cooling water system" program, then no further evaluation is recommended. In the "Discussion" column, VCSNS discusses the adequacy of the Chemistry Program in managing aging instead of using a closed-cycle cooling water system program.

The applicant further stated that at VCSNS, cracking due to SCC is an aging effect for stainless steel components in treated water environments (i.e., heat exchangers cooled by the component cooling water system). The Chemistry Program has proven effective at managing aging degradation in the component cooling water System as evidenced by the review of operating history in response to GL 89-13. Finally, the applicant stated that prior to the period of extended operation, one-time inspections will be conducted in low-flow areas of various treated water systems to demonstrate the effectiveness of the Chemistry Program.

On the basis of its review, the staff finds the applicant's response acceptable because the applicant has properly identified the basis of the difference between GALL and the LRA. In addition, prior to the period of extended operation, the applicant has committed to conduct one-time inspections in low-flow areas of various treated water systems to demonstrate the effectiveness of the Chemistry Program.

On the basis of its review of the information provided in the LRA and the additional information included in the applicant's response to the above RAIs, the staff finds that the aging effects that result from contact of the liquid waste processing system SSCs to the environments described in LRA Tables 2.3-9, 3.3-1, and 3.3-2 are consistent with industry experience for these combinations of materials and environments. Therefore, the staff finds that the applicant has identified the appropriate aging effects for the materials and environments associated with the components in the liquid waste processing system.

Aging Management Programs:

The applicant credited the following AMPs for managing the aging effects in the liquid waste processing system:

- Boric Acid Corrosion Surveillances Program (3.0.3.1)
- Chemistry Program (3.0.3.2)
- Maintenance Rule Structures Program (3.0.3.4)
- Liquid Waste System Inspection Program (3.3.2.3.14)

The Boric Acid Corrosion Surveillances Program, the Chemistry Program, and Maintenance Rule Structures Program are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common AMPs. The staff has evaluated these common AMPs and has found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Sections 3.0.3.1, 3.0.3.2, and 3.0.3.4, respectively, of this SER.

The staff has evaluated the system-specific Liquid Waste System Inspection AMP and has found it to be acceptable for managing the aging effects identified for this system. The staff's evaluation of this AMP is documented in Section 3.3.2.3.14 of this SER.

After evaluating the applicant's AMR for each of the components in the liquid waste processing system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects for this system. For those components identified in Table 3.3-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.3-2 , the staff verified that the applicant credited AMPs that are appropriate for the identified aging effects.

On the basis of its review, the staff finds that the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with liquid waste processing system. In addition, the staff finds the associated program descriptions in the FSAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

Conclusions:

On the basis of its review and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.3.2.4.15 Nuclear and Nonnuclear Plant Drains System

<u>Summary of Technical Information in the Application</u>

The description of the nuclear and nonnuclear plant drains can be found in Section 2.3.3.15 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3-29. The components, aging effects, and aging management programs are provided in the LRA Table 3.3-2.

Aging Effects:

The components in this group category described in Section 2.3.3.15 of the LRA are identified as being within the scope of license renewal and subject to an AMR. Tables 2.3-29 and 3.3-2 of the LRA, and the table entitled, "Virgil C. Summer Nuclear Station Database AMR Query," in the LRA supplement documents list individual components of the system.

The component groups of nuclear plant drains listed by the applicant in the VCSNS LRA include valves (body only) and pipe and fittings. Stainless steel components exposed to borated water are identified as subject to loss of material due to crevice corrosion, pitting corrosion, and cracking from SCC. Stainless steel components exposed to sheltered, reactor building, ventilation, and embedded in concrete environments are identified as having no aging effects.

The applicant identified the intended function of the nonnuclear plant drains system to be providing the circulating water pump trip function to prevent flooding in the control and

intermediate buildings. This is an active function. Therefore, the components in the non-nuclear plant drains are identified as not requiring aging management.

Aging Management Programs:

The following AMP is utilized to manage aging effects in the nuclear and nonnuclear plant drains:

- Liquid Waste System Inspection Program (B.2.3)

A description of this AMP is provided in Appendix B of the LRA. The applicant indicated that the effects of aging associated with the components of the nuclear plant drains will be adequately managed by this AMP during the period of extended operation.

Staff Evaluation

Aging Effects:

The staff reviewed the aging effects identified by the applicant for the components exposed to the environments of the nuclear and nonnuclear plant drains, as described in Section 2.3.3.15, Tables 2.3-29, and 3.3-2 of the LRA, as well as in the tables entitled, "Virgil C. Summer Nuclear Station Database AMR Query," and "Virgil C. Summer Nuclear Station Database AMR Query Notes," in the LRA supplement documents. During its review, the staff determined that additional information was needed.

Numerous tables included in the application list the component material and environment to which the component is exposed. However, the applicant did not provide a description of these environments in the LRA. By letter dated March 28, 2003, the staff issued RAI 3.3-1, pertaining to this issue of the plant-specific characteristics of the environment. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.1 of this SER and is characterized as resolved.

A common RAI (RAI 3.3-3), concerning the susceptibility to aging effects for stainless steel components in an ambient environment in the auxiliary systems is related to components of the nuclear and nonnuclear plant drains. RAI 3.3-3, and the applicant's response, is evaluated in Section 3.3.2.5.3 of this SER.

RAI B.2.3-1 is also relevant to the components of the nuclear and nonnuclear plant drains system. This RAI, together with the evaluation of applicant's response, is documented in Section 3.3.2.3.5 of this SER.

On the basis of its review of the information provided in the LRA and the additional information included in the applicant's response to the above RAIs, the staff finds that the aging effects that result from contact of the nuclear and nonnuclear plant drains SSCs to the environments described in LRA Tables 2.3-29, 3.3-1, and 3.3-2 are consistent with industry experience for these combinations of materials and environments. Therefore, the staff finds that the applicant has identified the appropriate aging effects for the materials and environments associated with the components in the nuclear and nonnuclear plant drains.

Aging Management Programs:

The applicant credited the following AMP for managing the aging effects in the nuclear and nonnuclear plant drains:

- Liquid Waste System Inspection Program (3.3.2.3.5)

The staff has evaluated the system-specific Liquid Waste System Inspection (AMP) and has found it to be acceptable for managing the aging effects identified for this system. The staff's evaluation of this AMP is documented in Section 3.3.2.3.5 of this SER.

The response to RAI B.2.3-1, for the Liquid Waste System Inspection Program clarified that the contents of the sumps contain leakage from high purity systems, and that the stainless steel containment penetrations managed by the AMP are also leak tested under 10 CFR Part 50 Appendix J. This RAI response also stated that operating experience at VCSNS for the nuclear drain system components managed by the program reveals no history of degradation for the internal surfaces.

After evaluating the applicant's AMR for each of the components in the nuclear and nonnuclear plant drains, the staff evaluated the AMP listed above to determine if it is appropriate for managing the identified aging effects for this system. For the components identified in LRA Table 3.3-2, the staff verified that the applicant credited AMPs that are appropriate for the identified aging effects.

On the basis of its review, the staff finds that the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with the nuclear and nonnuclear plant drains. In addition, the staff finds the associated program descriptions in the FSAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

Conclusions

On the basis of its review and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.3.2.4.16 Nuclear Sampling System

Summary of Technical Information in the Application

The description of the nuclear sampling system can be found in Section 2.3.3.16 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3-30. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1 and 3.3-2.

Aging Effects:

Components of the nuclear sampling system are described in Section 2.3.3.16 of the LRA as being within the scope of license renewal and subject to AMR. Table 2.3-30, 3.3-1, and 3.3-2 of the LRA, and the supplementary table and notes entitled, "Virgil C. Summer Nuclear Station Database AMR Query," list individual components of the system including heat exchanger (shell and tubes), pipe, pumps (casing only), tanks, tube and tube fittings, and valves (bodies only).

Loss of material is identified as an aging effect due to pitting, crevice, galvanic, and general corrosion for carbon steel components exposed to an internal environment of treated water. Loss of material from pitting and crevice corrosion, corrosion impact from alternate wetting and drying (for stainless steel), and cracking from SCC are identified as aging effects for stainless steel and nickel-based alloy components exposed to an internal environment of treated water. Loss of material is identified as an aging effect from pitting and crevice corrosion and cracking from SCC (for nickel-based alloy) for stainless steel and nickel-based alloy components exposed to an internal environment of borated water.

Loss of material is identified as an aging effect from general corrosion (for carbon steel) and MIC (for stainless steel) for carbon steel and stainless steel components exposed to an external reactor building or sheltered environment. No aging effect is identified for stainless steel components exposed to an external ventilation environment.

Aging Management Programs:

The following AMPs are utilized to manage aging effects in the nuclear sampling system:

- Inspections for Mechanical Components Program (B.2.11)
- Chemistry Program (B.1.4)
- Above Ground Tank Inspection Program (B.2.1)
- Maintenance Rule Structures Program (B.1.18)

A description of the AMP is provided in Appendix B of the LRA. The applicant indicated that the effects of aging associated with the components of the nuclear sampling system will be adequately managed by the identified AMPs during the period of extended operation.

Staff Evaluation

Aging Effect:

The staff reviewed the information in Section 2.3.3.16 and Tables 2.3-30, 3.3-1, and 3.3-2 in the LRA, as well as in the supplementary table and notes entitled, "Virgil C. Summer Nuclear Station Database AMR Query." During its review, the staff determined that additional information was needed.

Numerous tables included in the application list the component material and environment to which the component is exposed. However, the applicant did not provide a description of these environments in the LRA. By letter dated March 28, 2003, the staff issued RAI 3.3-1, pertaining to this issue of the plant-specific characteristics of the environment. The staff's

evaluation of the applicant’s response is documented in Section 3.3.2.5.1 of this SER and is characterized as resolved.

For carbon steel components exposed to external environments of moist air, such as reactor building or sheltered, the GALL Report identifies that loss of material is an aging effect that is caused by general, pitting, and crevice corrosion and MIC. The VCSNS LRA identifies loss of material as an aging effect due to general corrosion only. By letter dated March 28, 2003, the staff requested, in RAI 3.3.2.4.16-1, the applicant to justify why pitting or crevice corrosion or MIC does not occur for the carbon steel components exposed to external environments of moist air, such as reactor building or sheltered. If an insignificant concentration of contaminants is part of the technical basis, the staff also requested the applicant to provide the acceptance criterion used and the verification/inspection activities performed to justify its conclusion.

In its response dated June 12, 2003, the applicant stated that plant operating experience has identified the accumulation of microbiological organisms on the external surfaces of some piping components at building wall penetrations as a result of ground water intrusion effects. The structural design of the plant is such that any ground water intrusion in the sheltered environment is directed to sumps and away from equipment within the scope of license renewal. It is the residual presence of microbiological organisms that is of concern for subject mechanical components.

The applicant further stated that the VCSNS FSAR identifies a ground water elevation of 420' +/- 3'. Certain structures, such as the service water pumphouse, are potentially exposed to a ground water level of 425'. As such, piping, process tubing, and ductwork component types were conservatively considered to be susceptible to external MIC if they either enter a building from outside or pass between buildings included in the sheltered environment below the 425' elevation. Additionally, the susceptibility to external MIC was limited locally to the area of the interface with the pertinent wall. For building fire seal penetrations in the sheltered environment, the management of aging of the pertinent structural commodities precludes the accumulation of the necessary microbiological organisms, and thus MIC, on interfacing mechanical component types.

Therefore, the applicant indicated that loss of material due to MIC has been identified as an aging effect requiring system-specific evaluation in sheltered environments for piping, process tubing, and ductwork that pass between pertinent buildings through a nonfire seal penetration or which enter the building from outside below the 425' elevation.

The applicant further stated that building penetrations are inspected as part of the Maintenance Rule Structures Program (Application Section B.1.18). The VCSNS Corrective Action Program would disposition any ground water in-leakage and resulting degradation.

VCSNS is located well inland and in an area where forestry is the prime commercial activity. VCSNS does not see salt or other corrosive materials in the air from agriculture or industry. Crevice and pitting corrosion are not considered to be aging effects for external surfaces because the ambient environment does not contain contaminants of sufficient quantity to concentrate on external surfaces such that pitting or crevice corrosion would occur. Rainwater analyses reveal a concentration of less than 10 ppm for chlorides and sulfates.

Finally, the applicant stated that general corrosion of external surfaces of the nuclear sampling system will be managed by the Inspections for Mechanical Components Program this program will consist of a visual inspection of surfaces for any degradation or abnormality.

On the basis of its review, the staff finds that the applicant's response is acceptable because (1) the applicant has properly identified that the susceptibility to external MIC is limited locally to the area of the interface with the pertinent wall, (2) plant operating experience has identified the accumulation of microbiological organisms on the external surfaces of some piping components at building wall penetrations as a result of ground water intrusion effects, and (3) the ambient environment does not contain contaminants of sufficient quantity to concentrate on external surfaces such that pitting or crevice corrosion would occur. However, the staff questioned whether there are types of water other than ground water from intrusion (such as water from condensation) present in the sheltered environment such that loss of material from MIC may become an aging effect for the external surfaces of some of the applicable components of this system. The applicant was also requested to provide the justification, including operating experience, for not considering MIC from other types of water.

In its response dated September 2, 2003, the applicant stated that the ambient environment does not contain the nutrients necessary to promote external MIC in other types of water, such as water from condensation. In addition, because external MIC has not been found at locations other than at building penetrations, VCSNS does not specifically credit the Inspections for Mechanical Components Program for aging management for this aging effect. However, the applicant further stated that the Inspections for Mechanical Components Program will inspect for any abnormalities on external surfaces.

On the basis of its review, the staff finds the applicant's response acceptable because the applicant has properly identified that the ambient environment does not contain the nutrients necessary to promote external MIC in other types of water, such as water from condensation. In addition, the applicant has committed to use the Inspections for Mechanical Components Program to inspect for any abnormalities on external surfaces. All issues associated with this RAI 3.3.2.4.16-1 are considered resolved.

The nuclear sampling system contains borated water. However, the VCSNS B.1.2 Boric Acid Corrosion Surveillance AMP is not mentioned in the database AMR query table of the nuclear sampling system. By letter dated March 28, 2003, the staff requested, in RAI 3.3.2.4.16-2, the applicant to address how the loss of material from boric acid corrosion due to borated water leakage is managed for the components of the nuclear sampling system or to provide the basis for why this is not an applicable aging effect.

In its response dated June 12, 2003, the applicant stated that VCSNS considers boric acid corrosion to be an aging mechanism for carbon steel components in the nuclear sampling system. The applicant further stated that the Boric Acid Corrosion Surveillances Program will manage this aging mechanism. Table 2.3-30 of Section 2.3.3.16, "Nuclear Sampling System," of the application refers to Table 3.3-1, Item 13 in which the Boric Acid Corrosion Surveillances Program is discussed.

On the basis of its review, the staff finds the applicant's response acceptable because the applicant has properly identified boric acid corrosion to be an aging mechanism for carbon steel components in the nuclear sampling system. Furthermore, the Boric Acid Corrosion

Surveillances Program will manage this aging mechanism. All issues associated with RAI 3.3.2.4.16-2 are considered resolved.

On the basis of its review of the information provided in the LRA and the additional information included in the applicant's response to the above RAIs, the staff finds that the aging effects that result from contact of the nuclear sampling system SSCs to the environments described in LRA Tables 2.3-9, 3.3-1, and 3.3-2 are consistent with industry experience for these combinations of materials and environments. Therefore, the staff finds that the applicant has identified the appropriate aging effects for the materials and environments associated with the components in the nuclear sampling system.

Aging Management Programs:

The applicant credited the following AMPs for managing the aging effects in the nuclear sampling system:

- Inspections for Mechanical Components Program (3.0.3.7)
- Chemistry Program Program (3.0.3.2)
- Above Ground Tank Inspection Program (3.0.3.5)
- Maintenance Rule Structures Program (3.0.3.4)

The Inspections for Mechanical Components Program, Chemistry Program, Above Ground Tank Inspection Program, and Maintenance Rule Structures Program are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Sections 3.0.3.7, 3.0.3.2, 3.0.3.5, and 3.0.3.4, respectively, of this SER.

After evaluating the applicant's AMR for each of the components in the nuclear sampling system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects for this system. For those components identified in Table 3.3-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.3-2, the staff verified that the applicant credited AMPs that are appropriate for the identified aging effects.

On the basis of its review, the staff finds that the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with the nuclear sampling system. In addition, the staff finds the associated program descriptions in the FSAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

Conclusions

On the basis of its review and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement

for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.3.2.4.17 Radiation Monitoring System

Summary of Technical Information in the Application

The description of the radiation monitoring system can be found in Section 2.3.3.17 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3-31. The components, aging effects, and AMPs are provided in LRA Tables 3.3-1 and 3.3-2.

Aging Effects:

Components of the radiation monitoring system are described in Section 2.3.3.17 of the LRA as being within the scope of license renewal and subject to an AMR. Tables 2.3-31, 3.3-1, and 3.3-2 of the LRA, and the table entitled, "Virgil C. Summer Nuclear Station Database AMR Query," in the supplement list individual components of the system including pressure retaining instrumentation, pipe and fittings, tanks, tube and tube fittings, and valve bodies.

Stainless steel components are subject to the aging effect of loss of material of internal surfaces due to crevice and pitting corrosion from a treated or a borated water environment. External surfaces of stainless steel pipe and fittings are also subject to the aging effect of loss of material due to MIC from exposure to a sheltered environment. Exposure of other stainless steel components to a sheltered environment has no aging effect.

Aging Management Programs:

The following AMPs are utilized to manage aging effects in the radiation monitoring system:

- Chemistry Program (B.1.4)
- Maintenance Rule Structures Program (B.1.18)

A description of these AMPs is provided in Appendix B of the LRA. The applicant indicated that the effects of aging associated with the components of the radiation monitoring system will be adequately managed by these AMPs during the period of extended operation.

Staff Evaluation

Aging Effects:

The staff reviewed the information in Section 2.3.3.10 and Tables 2.3-31, 3.3-1, and 3.3-2 in the LRA, as well as in the tables entitled, "Virgil C. Summer Nuclear Station Database AMR Query," and "Virgil C. Summer Nuclear Station Database AMR Query Notes," in the supplement. During its review, the staff determined that additional information was needed.

Numerous tables included in the application list the component material and environment to which the component is exposed. However, the applicant did not provide a description of these environments in the LRA. By letter dated March 28, 2003, the staff issued RAI 3.3-1, pertaining

to this issue of the plant-specific characteristics of the environment. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.1 of this SER and is characterized as resolved.

The table, entitled "Virgil C. Summer Nuclear Station Database AMR Query," states that, for stainless steel pipe and fittings in a sheltered environment, the loss of material due to MIC can be managed for the period of extended operation by the applicant's Maintenance Rule Structures Program (B.1.18). The applicant also stated that exposure of other stainless steel components, such as pressure retaining instrumentation, tanks, tube and tube fittings, and valve bodies, to the same sheltered environment has no aging effect. By letter dated March 28, 2003, the staff requested, in RAI 3.3.2.4.17-1, the applicant to address and clarify this inconsistency.

In its response dated June 12, 2003, the applicant stated that plant operating experience has identified the accumulation of microbiological organisms on the external surfaces of some piping components at building wall penetrations as a result of ground water intrusion effects. The structural design of the plant is such that any ground water intrusion in the sheltered environment is directed to sumps and away from equipment within the scope of license renewal. It is the residual presence of microbiological organisms that is of concern for subject mechanical components.

The applicant further stated that the VCSNS FSAR identifies a ground water elevation of 420' +/- 3'. Certain structures, such as the service water pumphouse, are potentially exposed to a ground water level of 425'. As such, piping, process tubing, and ductwork component types were conservatively considered to be susceptible to external MIC if they either enter a building from outside or pass between buildings included in the sheltered environment below the 425' elevation. Additionally, the susceptibility to external MIC was limited locally to the area of the interface with the pertinent wall. For building fire seal penetrations in the sheltered environment, the management of aging of the pertinent structural commodities precludes the accumulation of the necessary microbiological organisms, and thus MIC, on interfacing mechanical component types.

The applicant indicated that loss of material due to MIC has been identified as an aging effect requiring system-specific evaluation in sheltered environments for piping, process tubing, and ductwork that pass between pertinent buildings through a nonfire seal penetration or which enter the building from outside below the 425' elevation.

The applicant further stated that during the integrated plant assessment for VCSNS it was deemed to be expeditious and conservative to assume that any plant system located in a sheltered environment was susceptible to MIC. This precluded the need to physically walk down or evaluate each system for this mechanism. As time permitted, systems would be evaluated or walked down to determine if indeed they were susceptible to MIC. If time did not permit, the assumption was conservative because the Maintenance Rule Structures Program looks at all walls and penetrations, and, therefore manages aging for any system at the susceptible locations. Finally, the applicant stated that, although listed in the LRA as an aging mechanism for stainless steel pipe in the radiation monitoring system, the portions of the radiation monitoring system in scope for license renewal are, in fact, not in locations where they would be susceptible to MIC.

On the basis of its review, the staff finds the applicant's response acceptable because that the applicant has properly identified that the susceptibility to external MIC is limited locally to the area of the interface with the pertinent wall where the accumulation of microbiological organisms on the external surfaces of some piping components at building wall penetrations results from ground water intrusion effects. Further, the portions of the radiation monitoring system in scope for license renewal are, in fact, not in locations where they would be susceptible to MIC. However, the staff questioned whether there are types of water other than ground water from intrusion (such as water from condensation) present in the sheltered environment such that loss of material from MIC may become an aging effect for the external surfaces of some of the applicable components of this system. The applicant was requested to provide the justification, including operating experience, for not considering MIC from other types of water.

In its response dated September 2, 2003, the applicant stated that the ambient environment does not contain the nutrients necessary to promote external MIC in other types of water, such as water from condensation. In addition, because external MIC has not been found at locations other than at building penetrations, VCSNS does not specifically credit the Inspections for Mechanical Components Program for aging management for this aging effect. However, the applicant further stated that the Inspections for Mechanical Components Program will inspect for any abnormalities on external surfaces.

On the basis of its review, the staff finds the applicant's response acceptable because the applicant has properly identified that the ambient environment does not contain the nutrients necessary to promote external MIC in other types of water, such as water from condensation, and the applicant has committed to use the Inspections for Mechanical Components Program to inspect for any abnormalities on external surfaces. All issues in RAI 3.3.2.4.17-1 are considered resolved.

Aging Management Programs:

The applicant credited the following AMPs for managing the aging effects in the radiation monitoring system:

- Chemistry Program (3.0.3.2)
- Maintenance Rule Structures Program (3.0.3.4)

The Chemistry Program and the Maintenance Rule Structures Program are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common AMPs. The staff has evaluated these common AMPs and has found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Sections 3.0.3.2 and 3.0.3.4, respectively, of this SER.

After evaluating the applicant's AMR for each of the components in the radiation monitoring system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects for this system. For those components identified in Table 3.3-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.3-2, the staff verified that the applicant credited AMPs that are appropriate for the identified aging effects.

On the basis of its review, the staff finds that the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with the radiation monitoring system. In addition, the staff finds the associated program descriptions in the FSAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

Conclusions

On the basis of its review and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.3.2.4.18 Reactor Makeup Water Supply System

Summary of Technical Information in the Application

The description of the reactor makeup water supply system can be found in Section 2.3.3.18 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3-32. The components, aging effects, and AMPs are provided in LRA Table 3.3-2.

Aging Effects:

The reactor makeup water supply system is described in Section 2.3.3.18 of the LRA as being within the scope of license renewal and subject to an AMR. Tables 2.3-32 and 3.3-2 of the LRA, and the supplementary table and notes entitled, "Virgil C. Summer Nuclear Station Database AMR Query," list individual components of the system including orifices, pipe and fittings, pump casings, tanks, tube and tube fittings, and valve bodies.

Stainless steel components are subject to the aging effects of loss of material due to crevice corrosion, pitting corrosion, and corrosive impacts of alternate wetting and drying, and cracking of internal surfaces due to SCC from a treated water environment. External surfaces of stainless steel pipe and fittings are also subject to the aging effect of loss of material due to MIC from exposure to a sheltered environment. Exposure of other stainless steel components to a sheltered, yard, or ventilation environment has no aging effect.

Aging Management Programs:

The following AMPs are utilized to manage aging effects in the reactor makeup water supply system:

- Chemistry Program (B.1.4)
- Maintenance Rule Structures Program (B.1.18)
- Above Ground Tank Inspection Program (B.2.1)

A description of these AMPs is provided in Appendix B of the LRA. The applicant indicated that the effects of aging associated with the components of the reactor makeup water supply system will be adequately managed by these AMPs during the period of extended operation.

Staff Evaluation

Aging Effect:

The staff reviewed the information in Section 2.3.3.18 and Tables 2.3-32 and 3.3-2 in the LRA, as well as in the supplementary table and notes entitled, "Virgil C. Summer Nuclear Station Database AMR Query." During its review, the staff determined that additional information was needed.

Numerous tables included in the application list the component material and environment to which the component is exposed. However, the applicant did not provide a description of these environments in the LRA. By letter dated March 28, 2003, the staff issued RAI 3.3-1, pertaining to this issue of the plant-specific characteristics of the environment. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.1 of this SER and is characterized as resolved.

In the table entitled, "Virgil C. Summer Nuclear Station Database AMR Query," the applicant stated that for stainless steel pipe and fittings in a sheltered environment, the loss of material due to MIC can be managed for the period of extended operation by the applicant's Maintenance Rule Structures Program (B.1.18). The applicant also stated that exposure of other stainless steel components, such as orifices, pump casings, tube and tube fittings, and valve bodies, to the same sheltered environment has no aging effect. By letter dated March 28, 2003, the staff requested, in RAI 3.3.2.4.18-1, the applicant to clarify this inconsistency.

In its response dated June 12, 2003, the applicant stated that plant operating experience has identified the accumulation of microbiological organisms on the external surfaces of some piping components at building wall penetrations as a result of ground water intrusion effects. The structural design of the plant is such that any ground water intrusion in the sheltered environment is directed to sumps and away from equipment within the scope of license renewal. It is the residual presence of microbiological organisms that is of concern for subject mechanical components.

The applicant further stated that the VCSNS FSAR identifies a ground water elevation of 420' +/- 3'. Certain structures, such as the service water pumphouse, are potentially exposed to a ground water level of 425'. As such, piping, process tubing, and ductwork component types were conservatively considered to be susceptible to external MIC if they either enter a building from outside or pass between buildings included in the sheltered environment below the 425' elevation. Additionally, the susceptibility to external MIC was limited locally to the area of the interface with the pertinent wall. For building fire seal penetrations in the sheltered environment, the management of aging of the pertinent structural commodities precludes the accumulation of the necessary microbiological organisms, and thus MIC, on interfacing mechanical component types.

The applicant indicated that therefore, loss of material due to MIC has been identified as an aging effect requiring system-specific evaluation in sheltered environments for piping, process

tubing, and ductwork that pass between pertinent buildings through a nonfire seal penetration or which enter the building from outside below the 425’ elevation.

Finally, the applicant stated that, for the reactor makeup water supply system, only piping penetrates buildings, therefore, only piping is susceptible to MIC.

On the basis of its review, the staff finds the applicant’s response acceptable because the applicant has properly identified that the susceptibility to external MIC is limited locally to the area of the interface with the pertinent wall where the accumulation of microbiological organisms on the external surfaces of some piping components at building wall penetrations results from ground water intrusion effects. Further, for the reactor makeup water supply system, only piping penetrates buildings; therefore, only piping is susceptible to MIC. However, the staff questioned whether there are types of water other than ground water from intrusion (such as water from condensation) present in the sheltered environment such that loss of material from MIC may become an aging effect for the external surfaces of some of the applicable components of this system. The applicant was also requested to provide the justification, including operating experience, for not considering MIC from other types of water.

In its response dated September 2, 2003, the applicant stated that the ambient environment does not contain the nutrients necessary to promote external MIC in other types of water, such as water from condensation. In addition, because external MIC has not been found at locations other than at building penetrations, VCSNS does not specifically credit the Inspections for Mechanical Components Program for aging management for this aging effect. However, the applicant further stated that the Inspections for Mechanical Components Program will inspect for any abnormalities on external surfaces.

On the basis of its review, the staff finds the applicant’s response acceptable because the applicant has properly identified that the ambient environment does not contain the nutrients necessary to promote external MIC in other types of water, such as water from condensation, and the applicant has committed to use the Inspections for Mechanical Components Program to inspect for any abnormalities on external surfaces. All issues associated with this RAI 3.3.2.4.18-1, are considered resolved.

On the basis of its review of the information provided in the LRA and the additional information included in the applicant’s response to the above RAIs, the staff finds that the aging effects that result from contact of the reactor makeup water supply system SSCs to the environments described in LRA Tables 2.3-9, 3.3-1, and 3.3-2 are consistent with industry experience for these combinations of materials and environments. Therefore, the staff finds that the applicant has identified the appropriate aging effects for the materials and environments associated with the components in the reactor makeup water supply system.

Aging Management Programs:

The applicant credited the following AMPs for managing the aging effects in the reactor makeup water supply system:

- Chemistry Program (3.0.3.2)
- Maintenance Rule Structures Program (3.0.3.4)
- Above Ground Tank Inspection Program (3.0.3.5)

The Chemistry Program, Maintenance Rule Structures Program, and Above Ground Tank Inspection Program are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common AMPs. The staff has evaluated these common AMPs and has found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Sections 3.0.3.2, 3.0.3.4, and 3.0.3.5, respectively, of this SER.

After evaluating the applicant's AMR for each of the components in the reactor makeup water supply system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects for this system. For those components identified in Table 3.3-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL Report. For the components identified in LRA Table 3.3-2, the staff verified that the applicant credited AMPs that are appropriate for the identified aging effects.

On the basis of its review, the staff finds that the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with the reactor makeup water supply system. In addition, the staff finds the associated program descriptions in the FSAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

Conclusions

On the basis of its review and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.3.2.4.19 Roof Drains System

Summary of Technical Information in the Application

The description of the roof drains system can be found in Section 2.3.3.19 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3-33. The components, aging effects, and AMPs are provided in LRA Table 3.3-2.

Aging Effects:

Components and the component group of the roof drains system are described in Section 2.3.3.19 of the LRA as being within the scope of license renewal and subject to an AMR. Tables 2.3-33 and 3.3-2 of the LRA and the table entitled, "Virgil C. Summer Nuclear Station Database AMR Query," in the supplement list system components and component groups.

The component groups in the roof drains system listed by the applicant in the VCSNS LRA include pipe and fittings. The applicant stated that stainless steel components exposed to borated water (condensate quality water with traces of boric acid) are subject to the aging effects of loss of material due to crevice corrosion, pitting corrosion, and cracking from SCC.

Stainless steel components of this system experience no aging effects while in a reactor building environment.

Aging Management Programs:

The following AMP is utilized to manage aging effects in the roof drains system:

- Reactor Building Cooling Unit Inspection Program (B.2.5)

A description of this AMP is provided in Appendix B of the LRA. The applicant indicated that the effects of aging associated with the components of the roof drains system will be adequately managed by this AMP during the period of extended operation.

Staff Evaluation

Aging Effects:

The staff reviewed the information in Section 2.3.3.19 and Tables 2.3-33 and 3.3-2 in the LRA, as well as in the tables entitled "Virgil C. Summer Nuclear Station Database AMR Query" and "Virgil C. Summer Nuclear Station Database AMR Query Notes" in the supplement. During its review, the staff found that additional information was needed to complete its review.

Numerous tables included in the application list the component material and environment to which the component is exposed. However, the applicant did not provide a description of these environments in the LRA. By letter dated March 28, 2003, the staff issued RAI 3.3-1, pertaining to this issue of the plant-specific characteristics of the environment. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.1 of this SER, and is characterized as resolved.

A general RAI (RAI 3.3-3), which is applicable to the roof drains system on the susceptibility to aging effects for stainless steel components in ambient environment has been raised by the staff. The details of the RAI, the applicant's response and the staff's evaluation is described in Section 3.3.2.5 General AMR Issues. By letter dated March 28, 2003, the staff issued RAI 3.3-3, pertaining to this issue of the susceptibility to aging effects for stainless steel components in ambient environment. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.3 of this SER.

RAI B.2.5-2, on the AMP Reactor Building Cooling Unit Inspection (B.2.5) concerning boric acid corrosion has also been raised by the staff. The details of the RAI, the applicant's response and the staff's evaluation is documented in Section 3.3.2.3.6 of this SER.

Aging Management Programs:

The applicant credited the following AMP for managing the aging effects in the roof drains system:

- Reactor Building Cooling Unit Inspection (Section 3.3.2.3.6)

The staff has evaluated this AMP and has found it to be acceptable for managing the aging effects identified for this system. The staff's evaluation of this AMP is documented in Section 3.3.2.3.6 of the SER.

After evaluating the applicant's AMR for each of the components in the roof drains system , the staff evaluated the AMP listed above to determine if it is appropriate for managing the identified aging effects for this system. For the components identified in LRA Table 3.3-2, the staff verified that the applicant credited the aging management program that is appropriate for the identified aging effects.

In the table entitled "Virgil C. Summer Nuclear Station Database AMR Query", the applicant stated that stainless steel piping and fitting component of the roof drains system is subjected to the aging effect of cracking from stress corrosion cracking in a borated water environment. LRA Table 3.3-2 Item 22 identifies that the stainless steel drain lines are less than 140Fand are not susceptible to SCC but are susceptible to crevice or pitting corrosion. AMP B.2.5 is actually credited with managing SCC in addition to crevice and pitting corrosion which is acceptable to the staff.

On the basis of its review, the staff finds the applicant has credited the appropriate AMP to manage the aging effects for the materials and environments associated with the roof drains system . In addition, the staff finds the associated program description in the FSAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

Conclusions

On the basis of its review, the staff concludes that the applicant has adequately identified the aging effects, and AMPs credited for managing the aging effects, for components in the roof drains system, such that there is reasonable assurance that the component intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable FSAR Supplement program descriptions and concludes that the FSAR Supplement provides an adequate program description of the AMP credited for managing aging in the roof drains system as required by 10 CFR 54.21(d).

3.3.2.4.20 Station Service Air System

Summary of Technical Information in the Application

The description of the station service air system can be found in Section 2.3.3.20 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3-34. The components, aging effects, and aging management programs are provided in LRA Tables 3.3-1 and 3.3-2.

Aging Effects:

Components and component group of the station service air system are described in Section 2.3.3.20 of the submittal as being within the scope of license renewal and subject to an AMR. Tables 2.3-34, 3.3-1, and 3.3-2 of the LRA and the table entitled Virgil C. Summer Nuclear

Station Database AMR Query in the supplement list system components and components group.

The component groups in this category in the station service air system listed by the applicant in the VCSNS LRA include pipe and fittings, tube and tube fittings, and valves (body only). The applicant states that carbon steel components exposed to air-gas, reactor building, and sheltered environments are subject to aging effect of loss of material due to general corrosion. Stainless steel components of this system experience no aging effects while in air-gas, reactor building, and sheltered environments.

Aging Management Programs:

The following AMPs are utilized to manage aging effects in the station service air system :

- Boric Acid Corrosion Surveillances (B.1.2)
- Service Air System Inspection (B.2.6)
- Inspections for Mechanical Components (B.2.11)

A description of these aging management programs is provided in Appendix B of the LRA. The applicant states that the effect of aging associated with the components of the station service air system will be adequately managed by these aging management programs during the period of extended operation.

Staff Evaluation

Aging Effects:

The staff reviewed the information in Section 2.3.3.20 and Tables 2.3-34, 3.3-1, and 3.3-2 in the LRA, as well as in the tables entitled Virgil C. Summer Nuclear Station Database AMR Query and Virgil C. Summer Nuclear Station Database AMR Query Notes in the supplement. During its review, the staff found that additional information was needed to complete its review.

Numerous tables included in the application list the component material and environment to which the component is exposed. However, the applicant did not provide a description of these environments in the LRA. By letter dated March 28, 2003, the staff issued RAI 3.3-1, pertaining to this issue of the plant- specific characteristics of the environment . The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.1 of this SER, and is characterized as resolved.

By letter dated March 28, 2003, the staff issued RAI 3.3-3, pertaining to this issue of the susceptibility to aging effects for stainless steel components in ambient environment. The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.3 of this SER and is characterized as resolved.

Normally station service air system may contain elastomer materials in hose connection seals, duct seals, flexible collars between ducts and fans, rubber boots, etc. For some plant designs, elastomer components are used as vibration isolators to prevent transmission of vibration and dynamic loading to the rest of the system. The aging effects on those elastomer components are hardening and loss of material. However, no elastomer component associated with the

station service air system was listed in the LRA. By letter dated March 28, 2003, the staff requested , in RAI 3.3.2.4.20-1, the applicant to clarify whether there are elastomer components present in the Station Service Air System and if so, address the management of the aging effects of hardening and loss of material on the elastomer components.

In its response dated June 13, 2003, the applicant stated that there are no elastomer components in the portions of the station service air system that are in scope for license renewal.

On the basis of its review, the staff finds that the applicant's response acceptable because the applicant has clarified that there are no elastomer components in the portions of the station service air system that are in scope for license renewal.

Loss of material due to boric acid corrosion for components adjacent to a source of borated water is an aging effect for carbon steel components. In the VCSNS Database AMR Query table, the applicant identified some carbon steel components in the reactor building and sheltered environments are subject to such an aging effect and some are not. By letter dated March 28, 2003, the staff requested , in RAI 3.3.2.4.20-2, the applicant to explain why different conclusions are attained for components with the same material/environment combination.

In its response dated June 13, 2003, the applicant stated that for license renewal considerations, a "sheltered" environment is considered to be the ambient conditions inside certain support buildings. These support buildings include the auxiliary (AB), control (CB), intermediate (IB), fuel handling (FHB), diesel generator (DB), service (SB), and turbine (TB) buildings. A "sheltered" environment also includes the fire pump house (FPH), and service water pump house (SWPH). There are some sheltered environments that do not house systems that contain borated water; therefore, in these particular sheltered environments boric acid corrosion is not an aging mechanism; however, VCSNS does consider boric acid corrosion as an aging mechanism for the station service air system components in scope for license renewal. Finally the applicant stated that Table 2.3-34 of the LRA Section 2.3.3.20, station service air system, refers to Table 3.3-1, Item 13, where the Boric Acid Corrosion Surveillances Program is discussed.

On the basis of its review, the staff finds that the applicant's response acceptable because the applicant has properly identified that there are some sheltered environments that do not house systems that contain borated water; therefore, in these particular sheltered environments boric acid corrosion is not an aging mechanism and hence this justifies why different conclusions are attained for components with the same material/environment combination.

On the basis of its review of the information provided in the LRA and the additional information included in the applicant's response to the above RAIs, the staff finds that the aging effects that result from contact of the station service air system SSCs to the environments described in Tables 2.3-9, 3.3-1 and 3.3-2 are consistent with industry experience for these combinations of materials and environments. Therefore, the staff finds that the applicant has identified the appropriate aging effects for the materials and environments associated with the components in the station service air system .

Aging Management Programs:

The applicant credited the following AMP for managing the aging effects in the station service air system :

- Boric Acid Corrosion Surveillances (3.0.3.1)
- Service Air System Inspection (3.3.2.3.7)
- Inspections for Mechanical Components (3.0.3.7)

The Boric Acid Corrosion Surveillances, and Inspections for Mechanical Components AMPs are credited for managing the aging effects of several components in different structures and systems and are, therefore, considered common aging management programs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. These common AMPs are evaluated in Sections 3.0.3.1 and 3.0.3.7 of this SER.

The staff has evaluated the system-specific AMP Service Air System Inspection and has found it to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Sections 3.3.2.3.7 of this SER.

After evaluating the applicant's AMR for each of the components in the station service air system , the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects for this system. For those components identified in Table 3.3-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL report. For the components identified in LRA Table 3.3-2 , the staff verified that the applicant credited aging management programs that is appropriate for the identified aging effects.

On the basis of its review, the staff finds the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with the station service air system . In addition, the staff finds the associated program descriptions in the FSAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

Conclusions

On the basis of its review, the staff concludes that the applicant has adequately identified the aging effects, and AMPs credited for managing the aging effects, for components in the station service air system , such that there is reasonable assurance that the component intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable FSAR Supplement program descriptions and concludes that the FSAR Supplement provides an adequate program description of the AMPs credited for managing aging in the station service air system to satisfy 10 CFR 54.21(d).

3.3.2.4.21 Service Water System

Summary of Technical Information in the Application

The description of the service water system can be found in Section 2.3.3.21 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA

Table 2.3-35. The components, aging effects, and aging management programs are provided in LRA Tables 3.3-1 and 3.3-2.

Aging Effects:

Components and component group of the service water system are described in Section 2.3.3.21 of the submittal as being within the scope of license renewal and subject to an AMR. Tables 2.3-35, 3.3-1, and 3.3-2 of the LRA and the table entitled Virgil C. Summer Nuclear Station Database AMR Query in the supplement list system components and components group.

The component types in this category in the service water system listed by the applicant in the VCSNS LRA include couplings, (coolers, motor bearings), (expansion joints, mechanical, piping), (expansion joints, mechanical, bellows), orifices, pipe, (thermowells, piping), pipe and fittings, pumps (casing only), trash racks, (traveling screens, cloth screen), (traveling screens, screen frames), tube and tube fittings, and valves (body only). The applicant stated that carbon steel, stainless steel, and copper components of this system exposed to raw water environment are subject to the aging effects of loss of material from crevice, general, galvanic, pitting and micro biologically influenced corrosion, and erosion, and heat exchanger fouling from biological materials and particulates. Carbon steel components in underground, reactor building, and sheltered environments are subjected to loss of materials from general, galvanic, pitting and MIC as well as crevice, and boric acid corrosion (for the reactor building, and sheltered environments only). There are no aging effects for carbon steel components in embedded environment. The applicant stated that stainless steel components in the reactor building, and sheltered environments have no aging effects except for tube and tube fittings in some sheltered environment for the aging effect of loss of material from MIC is identified. Copper components also has no aging effect in oil environment.

Aging Management Programs:

The following AMPs are utilized to manage aging effects in the service water system :

- Service Water System Reliability and In-Service Testing Program (B.1.9)
- Boric Acid Corrosion Surveillances (B.1.2)
- Buried Piping and Tanks Inspection (B.2.10)
- Maintenance Rule Structures Program (B.1.18)
- Inspections for Mechanical Components (B.2.11)

A description of these aging management programs is provided in Appendix B of the LRA. The applicant states that the effect of aging associated with the components of the service water system will be adequately managed by these aging management programs during the period of extended operation.

Staff Evaluation

Aging Effects:

The staff reviewed the information in Section 2.3.3.21 and Tables 2.3-35, 3.3-1, and 3.3-2 in the LRA, as well as in the tables entitled Virgil C. Summer Nuclear Station Database AMR Query

and Virgil C. Summer Nuclear Station Database AMR Query Notes in the supplement. During its review, the staff found that additional information was needed to complete its review.

Numerous tables included in the application list the component material and environment to which the component is exposed. However, the applicant did not provide a description of these environments in the LRA. By letter dated March 28, 2003, the staff issued RAI 3.3-1, pertaining to this issue of the plant- specific characteristics of the environment . The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.1 of this SER, and is characterized as resolved.

The applicant stated in the VCSNS Database AMR Query Table that galvanic corrosion is one of the applicable aging mechanism that give rise to the aging effect of loss of materials. The component group affected in this category for the service water system includes carbon steel couplings, and pipe and fittings in an underground environment. The Buried Piping and Tanks Inspection is stated as the applicable AMP. The applicant further stated that this AMP will be consistent with XI.M34, Buried Piping and Tanks Inspection, as identified in NUREG -1801 prior to the period of extended operation. It should be noted that the likelihood and extent of galvanic corrosion depends on the relative position of the contacting metal/alloys on the galvanic potential chart, the electrolyte, immersion time and geometrical factors and many of these factors are location-dependent. By letter dated March 28, 2003, the staff requested , in RAI 3.3.2.4.21-1, the applicant to clarify whether the buried piping and tanks inspections are to be performed in areas with the highest likelihood on galvanic corrosion or are to be performed on an opportunistic basis and to provide justifications for either case.

In its response dated June 13, 2003, the applicant stated that the buried portions of the Service Water (SW) System are all carbon steel; therefore, the only possible galvanic reaction would be between the wrapped/coated piping components and the soil. All buried SW components are therefore equally susceptible and the opportunistic basis of the Buried Piping and Tanks Inspection is sufficient. VCSNS coats and wraps underground components in accordance with site procedures, which are based on accepted industry standard AWWA C-203, 1973. Finally the applicant stated that operating experience for the Diesel Generator Fuel Oil Storage Tanks revealed that negligible wall thinning had occurred thereby verifying that the techniques of coating and wrapping are effective.

On the basis of its review, the staff finds that the applicant's response acceptable because the applicant has properly identified that the only possible galvanic reaction would be between the wrapped/coated piping components and the soil and that all buried SW components are therefore equally susceptible and the opportunistic basis of the Buried Piping and Tanks Inspection is sufficient.

For carbon steel component in the sheltered and reactor building environments of VCSNS loss of materials from aging mechanisms other than boric acid corrosion (such as general corrosion, galvanic corrosion) may be an applicable aging effect. By letter dated March 28, 2003, the staff requested, in RAI 3.3.2.4.21-2, the applicant to identify the applicable aging effects and the associated AMPs or to provide the technical basis to justify no other applicable aging effects for these components.

In its response dated June 13, 2003, the applicant stated that for carbon steel components in the sheltered and reactor building environments, the Inspections for Mechanical Components

will manage loss of material from galvanic and general corrosion. There are locations in sheltered environments where carbon steel components are susceptible to MIC. The applicant further stated that loss of material due to MIC is managed for these susceptible components by the Maintenance Rule Structures Program.

On the basis of its review, the staff finds that the applicant's response concerning MIC is acceptable because that the applicant has properly identified that the AMPs Inspections for Mechanical Components will manage loss of material from galvanic and general corrosion and that the Maintenance Rule Structures Program will manage MIC. However, the staff noted that the likelihood and extent of galvanic corrosion depends on the contact between different metals or alloys with relative separation of the contacting metal/alloys on the galvanic potential chart, the electrolyte, immersion time and geometrical factors. Many of these factors are location-dependent. The staff therefore, requested the applicant to clarify whether in using the AMP Inspections for Mechanical Components to manage the galvanic corrosion the inspection is to be performed in areas with the highest likelihood on galvanic corrosion or are to be performed on an opportunistic basis.   The applicant is requested to provide justifications for either case.

In its response dated September 2, 2003, the applicant stated that although galvanic corrosion normally does not occur in the absence of a completely wetted environment, the Inspections for Mechanical Components will manage galvanic corrosion for external surfaces of components by periodic inspections for any surface abnormalities.

On the basis of its review, the staff finds that the applicant's response acceptable because the applicant has committed to use the Inspections for Mechanical Components to manage galvanic corrosion for external surfaces of components by periodic inspections for any surface abnormalities. All issues in RAI 3.3.2.4.21-2, are considered resolved.

The staff noted that the Query Notes (A-SW-f) states that "loss of material due to MIC is an aging effect for stainless steel components, and is a potential problem in sheltered environments where contamination from untreated water or soil may have introduced bacteria. VCSNS operating experience has identified the accumulation of microbiological organisms on the external surfaces of some piping components at building wall penetrations as a result of groundwater intrusion effects. The VCSNS AMR has conservatively considered all piping, process tubing and ductwork component types to be susceptible to external MIC if they either enter a building from the outside or pass between buildings included in the sheltered environment below the 425' elevation. Loss of material due to MIC is only an aging effect requiring management for the stainless steel process tubing which passes between buildings below the 425' elevation."

In the VCSNS Database AMR Query table, the applicant identified no aging effect for stainless steel expansion joints, mechanical -bellows, orifices, valves (body only) or pipe and fittings (thermowells) in a sheltered environment. The staff also noted that the applicant identified loss of materials from MIC as an applicable aging effect for stainless steel tube and tube fittings in a sheltered environment. By letter dated March 28, 2003, the staff requested, in RAI 3.3.2.4.21-3, the applicant to clarify the applicability of the discussion in VCSNS Database AMR Query Notes (A-SW-f) quoted above, and to justify the different conclusion for the identified components. In particular, the applicant was requested to clarify which components mentioned above are above or below the 425' elevation and provide the basis for not including MIC as an applicable aging mechanism for the aging effect of loss of materials.

The applicant also does not identify any aging effect for stainless steel tube and tube fittings, valves (body only) in the reactor building environment. The staff requested the applicant to provide justification for this omission and, if insignificant concentration of contaminants is part of the justification, to provide the acceptance criterion and the verification/inspection activities on susceptible locations to justify the conclusion.

In its response dated June 13, 2003, the applicant stated that the susceptibility to external MIC is limited locally to the area of the interface with the pertinent wall where groundwater in-leakage can occur. Only piping, process tubing, and ductwork component types pass through building penetrations. For the stainless steel components of the service water (SW) system, only process tubing can meet these criteria in sheltered environments.

The applicant further stated that VCSNS is located well inland and is located in an area where forestry is the primary commercial activity. VCSNS does not see salt or other corrosive materials in the air from agriculture or industry. Rainwater analyses reveal a concentration of less than 10 ppm for chlorides and sulfates. Because the ambient environment at VCSNS is not considered to be a corrosive environment, stress corrosion cracking, crevice corrosion, and pitting corrosion are not considered to be aging mechanisms to be managed for external surfaces of stainless steel components. There are no locations in the reactor building where stainless steel components of the SW system are exposed to groundwater in-leakage; therefore, these components are not susceptible to MIC. Finally the applicant stated that this is consistent with the operating experience reviews conducted at VCSNS.

On the basis of its review, the staff finds that the applicant’s response acceptable because that the applicant has properly identified that the susceptibility to external MIC is limited locally to the area of the interface with the pertinent wall where groundwater in-leakage can occur and that only piping, process tubing, and ductwork component types pass through building penetrations. For the stainless steel components of the SW system, only process tubing can meet these criteria in sheltered environments. The applicant also properly clarified that the ambient environment at VCSNS is not considered to be a corrosive environment. However, the staff questioned whether there are other types of water (such as water from condensation) other than ground water from intrusion present in the sheltered environment such that loss of material from MIC may become an applicable aging effect for the external surfaces of some of the applicable components of this system. The applicant was requested to provide the justification for not considering MIC from other types of water, including operating experience.

In its response dated September 2, 2003, the applicant stated that the ambient environment does not contain nutrients necessary to promote external MIC in other types of water, such as water from condensation and that because external MIC has not been found at locations other than at building penetrations, VCSNS does not specifically credit the Inspections for Mechanical Components for aging management for this aging effect; however, the applicant further stated that the Inspections for Mechanical Components will inspect for any abnormalities on external surfaces.

On the basis of its review, the staff finds that the applicant’s response acceptable because that the applicant has properly identified that the ambient environment does not contain nutrients necessary to promote external MIC in other types of water, such as water from condensation and that the applicant has committed to use the Inspections for Mechanical Components

program to inspect for any abnormalities on external surfaces. All issues in RAI 3.3.2.4.21-3, are considered resolved

The applicant identifies no applicable aging effect for carbon steel components in an embedded environment. The applicant is requested to provide the specification for the embedded environment. If this environment involves concrete, corrosion of carbon steel components embedded in concrete through carbonation etc., is commonly known degradation process. By letter dated March 28, 2003, the staff requested , in RAI 3.3.2.4.21-4, the applicant to provide the basis for the concluding that no applicable aging effect exists for carbon steel components in this particular embedded environment.

In its response dated June 13, 2003, the applicant stated that corrosion of embedded steel is not significant if the concrete has a low water-to-cement ratio, low permeability, and designed in accordance with ACI standards (ACI-318 or ACI-349, depending on the building). Finally the applicant stated that the design and construction of structures at VCSNS meet these criteria; therefore, the applicant concluded that corrosion of embedded steel is not an aging effect requiring management at VCSNS.

On the basis of its review, the staff finds that the applicant's response acceptable because the applicant has properly identified that the design and construction of structures at VCSNS meet the criteria of low water-to-cement ratio, low permeability, and designed in accordance with ACI standards (ACI-318 or ACI-349, depending on the building).

On the basis of its review of the information provided in the LRA and the additional information included in the applicant's response to the above RAIs, the staff finds that the aging effects that result from contact of the SW system SSCs to the environments described in Tables 2.3-9, 3.3-1 and 3.3-2 are consistent with industry experience for these combinations of materials and environments. Therefore, the staff finds that the applicant has identified the appropriate aging effects for the materials and environments associated with the components in the service water system.

Aging Management Programs

The applicant credited the following AMP for managing the aging effects in the SW system:

- Service Water System Reliability and In-Service Testing Program (Section 3.3.2.3.1)
- Boric Acid Corrosion Surveillances (Section 3.0.3.1)
- Buried Piping and Tanks Inspection (Section 3.0.3.6)
- Maintenance Rule Structures Program (Section 3.0.3.4)
- Inspections for Mechanical Components (Section 3.0.3.7)

The Boric Acid Corrosion Surveillances, Buried Piping and Tanks Inspection, Maintenance Rule Structures Program, and Inspections for Mechanical Components AMPs are credited for managing the aging effects of several components in different structures and systems and are, therefore, considered common aging management programs. The staff has evaluated these common AMPs and has found them to be acceptable for managing the aging effects identified for this system. The staff's review of the common aging management programs is documented in Section 3.0.3.1, 3.0.3.6, 3.0.3.4, and 3.0.3.7 of this SER.

The staff has evaluated the system-specific AMPs Service Water System Reliability and In-Service Testing Program and has found it to be acceptable for managing the aging effects identified for this system.   The staff's evaluation of these AMPs is documented in Sections 3.3.2.3.1 of this SER.

After evaluating the applicant's AMR for each of the components in the SW system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects for this system. For those components identified in Table 3.3-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL report. For the components identified in LRA Table 3.3-2 , the staff verified that the applicant credited aging management programs that is appropriate for the identified aging effects.

On the basis of its review, the staff finds the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with the SW system . In addition, the staff finds the associated program descriptions in the FSAR Supplement to be acceptable to satisfy 10 CFR 54.21(d)..

Conclusions

On the basis of its review, the staff concludes that the applicant has adequately identified the aging effects, and AMPs credited for managing the aging effects, for components in the SW system, such that there is reasonable assurance that the component intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable FSAR Supplement program descriptions and concludes that the FSAR Supplement provides an adequate program description of the AMPs credited for managing aging in the SW system to satisfy 10 CFR 54.21(d).

3.3.2.4.22 Spent Fuel Cooling System

Summary of Technical Information in the Application

The description of the spent fuel cooling system can be found in Section 2.3.3.22 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3-36. The components, aging effects, and aging management programs are provided in LRA Tables 3.3-1 and 3.3-2.

Aging Effects:

Components of the spent fuel cooling system are described in Section 2.3.3.22 of the submittal as being within the scope of license renewal, and subject to AMR. Table 2.3-36, 3.3-1 and 3.3-2, of the LRA and the supplementary table and notes, entitled "Virgil C. Summer Nuclear Station Database AMR Query," list individual components of the system including heat exchangers (channel head), heat exchangers (shell), heat exchangers (tubes), heat exchangers (tubesheet), orifices, pipe pumps (casing only,) tube and tube fittings, and valves (body only).

Loss of material is identified as aging effect for carbon steel and stainless steel components exposed to internal environment of treated water. Loss of material and cracking are identified as aging effects for stainless steel refueling water storage tank (RWST) exposed to internal environment of borated water due to alternate wet and dry at borated water surface. Loss of material due to crevice and pitting corrosion is identified as aging effects for stainless steel components exposed to internal environment of borated water other than RWST. No aging effect is identified for stainless steel components exposed to internal ventilation (i.e., moisture air) environment. Cracking is not identified as an aging effect for components exposed to borated water or treated water because the system is normally operated well below 140° F.

Loss of material due to boric acid corrosion is identified as aging effect for carbon steel and stainless steel components exposed to sheltered environment. Loss of material due to micro biologically influenced corrosion is identified as an aging effect for vulnerable stainless steel components including pipe and tubing exposed to sheltered environment. Loss of material due to micro biologically influenced corrosion is not identified as aging effect for stainless steel components other than pipe and tubing exposed to sheltered environment. No aging effect is identified for stainless steel components exposed to yard environment.
.
Aging Management Programs:

The following AMPs are utilized to manage aging effects in the spent fuel cooling system:

- Chemistry program (B.1.4)
- Boric Acid Corrosion Surveillance (B.1.4)
- Maintenance Rule Structures Program (B.1.18)
- Above Ground Tank Inspection (B.2.1)

A description of the aging management program is provided in Appendix B of the LRA. The applicant states that the effect of aging associated with the components of the spent fuel cooling system will be adequately managed by the aging management program during the period of extended operation.

Staff Evaluation

Aging Effect:

The staff reviewed the information in Section 2.3.3.22 and Tables 2.3-36, 3.3-1 and 3.3-2 in the LRA; as well as in the supplementary table and notes, entitled "Virgil C. Summer Nuclear Station Database AMR Query." The applicant has stated that cracking is not identified as an aging effect for components exposed to borated water or treated water because the system is normally operated well below 140° F. The staff agrees that cracking is not an aging effect for spent fuel cooling system components exposed to borated water or treated water because temperature of the borated water or treated water is below 140°F. Below 140°F, stress corrosion cracking is not an aging effect requiring aging management.
However, during its review, the staff determined that additional information was needed to complete its review.
Numerous tables included in the application list the component material and environment to which the component is exposed. However, the applicant did not provide a description of these environments in the LRA. By letter dated March 28, 2003, the staff issued RAI 3.3-1,

pertaining to this issue of the plant- specific characteristics of the environment . The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.1 of this SER, and is characterized as resolved.

On page 211 of the VCSNS Database AMR Query Notes, the applicant states that loss of material due to MIC is identified as an aging effect for vulnerable stainless steel components including pipe and tubing of the spent fuel cooling system exposed to sheltered environment. However, loss of material due to MIC is not identified by the applicant as an aging effect for stainless steel components other than pipe and tubing. By letter dated March 28, 2003, the staff requested , in RAI 3.3.2.4.22-1, to provide justification as to why loss of material due to MIC is identified as an aging effect only for stainless steel pipe and tubing components and not for other stainless steel components such as heat exchangers, orifices, pumps, and valves.

In its response dated June 13, 2003, the applicant stated that the susceptibility to external MIC is limited locally to the area of the interface with the pertinent wall where groundwater in-leakage can occur. Only piping, process tubing, and ductwork component types pass through building penetrations. Finally the applicant stated that for the stainless steel components of the spent fuel cooling system, only pipe and pipe fitting components meet these criteria.

On the basis of its review, the staff finds that the applicant's response acceptable because that the applicant has properly identified that the susceptibility to external MIC is limited locally to the area of the interface with the pertinent wall where groundwater in-leakage can occur and that for the stainless steel components of the boron thermal regeneration system, only pipe and pipe fitting components meet these criteria. However, the staff questioned whether there are other types of water (such as water from condensation) other than ground water from intrusion present in the sheltered environment such that loss of material from MIC may become an applicable aging effect for the external surfaces of some of the applicable components of this system. The applicant was requested to provide the justification for not considering MIC from other types of water, including operating experience.

In its response dated September 2, 2003, the applicant stated that the ambient environment does not contain nutrients necessary to promote external MIC in other types of water, such as water from condensation and that because external MIC has not been found at locations other than at building penetrations, VCSNS does not specifically credit the Inspections for Mechanical Components for aging management for this aging effect; however, the applicant further stated that the Inspections for Mechanical Components will inspect for any abnormalities on external surfaces.

On the basis of its review, the staff finds that the applicant's response acceptable because the applicant has properly identified that the ambient environment does not contain nutrients necessary to promote external MIC in other types of water, such as water from condensation and that the applicant has committed to use the Inspections for Mechanical Components program to inspect for any abnormalities on external surfaces. All issues associated with this RAI 3.3.2.4.22-1, are considered resolved.

On the basis of its review of the information provided in the LRA and the additional information included in the applicant's response to the above RAIs, the staff finds that the aging effects that result from contact of the spent fuel cooling system SSCs to the environments described in Tables 2.3-36, 3.3-1 and 3.3-2 are consistent with industry experience for these combinations

of materials and environments. Therefore, the staff finds that the applicant has identified the appropriate aging effects for the materials and environments associated with the components in the spent fuel cooling system.

Aging Management Programs:

The applicant credited the following aging management programs are credited for managing the aging effects in the spent fuel cooling system.

- Chemistry Program (Section 3.0.3.2)
- Boric Acid Corrosion Surveillance (Section 3.0.3.1)
- Maintenance Rule Structures Program (Section 3.0.3.4,)
- Above Ground Tank Inspection (Section 3.0.3.5)

The Chemistry program, Boric Acid Corrosion Surveillance, Maintenance Rule Structures Program, and Above Ground Tank Inspection Program are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common aging management programs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Section 3.0.3.2, 3.0.3.1, 3.0.3.4, and 3.0.3.5 of this SER.

After evaluating the applicant's AMR for each of the components in the spent fuel cooling system , the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects for this system. For those components identified in Table 3.3-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL report. For the components identified in LRA Table 3.3-2 , the staff verified that the applicant credited aging management programs that is appropriate for the identified aging effects.

On the basis of its review, the staff finds the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with spent fuel cooling system . In addition, the staff finds the associated program descriptions in the FSAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

<u>Conclusion</u>

On the basis of its review, the staff concludes that the applicant has adequately identified the aging effects, and AMPs credited for managing the aging effects, for components in the spent fuel cooling system , such that there is reasonable assurance that the component intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable FSAR Supplement program descriptions and concludes that the FSAR Supplement provides an spent fuel cooling system water system to satisfy 10 CFR 54.21(d).

3.3.2.4.23 Thermal Regeneration System

Summary of Technical Information in the Application

The description of the thermal regeneration system can be found in Section 2.3.3.23 of this SER. The passive, long-lived components in this system that are subject to an AMR are identified in LRA Table 2.3-37. The components, aging effects, and aging management programs are provided in LRA Tables 3.3-1 and 3.3-2.

Aging Effects:

Components of the Thermal Regeneration System are described in Section 2.3.3.23 of the submittal as being within the scope of license renewal and subject to an AMR. Tables 2.3-37, 3.3-1, and 3.3-2 of the LRA and the supplementary table and notes, entitled "Virgil C. Summer Nuclear Station Database AMR Query," list system components and component group.

The component groups in this category in the thermal regeneration system listed by the applicant in the VCSNS LRA include demineralizers(XDM0007A/B/C/D); heat exchanger (XHE0001), moderating – channel head; heat exchanger (XHE0001), moderating –shell; heat exchanger (XHE0008), letdown chiller – channel head; heat exchanger (XHE0015), letdown reheat – shell; heat exchanger (XHE0015), letdown reheat – tubes; heat exchanger (XHE0015), letdown reheat – tubesheet(s); orifices (IFE00385); pipe and fittings; tube and tube fittings; and valves (body Only). The applicant states that the stainless steel components, except pipe and pipe fittings, exposed to ventilation and sheltered environments in Thermal Regeneration System experience no aging effects. Stainless steel pipe and pipe fittings of the thermal regeneration system in the sheltered environment are identified as subject to aging effect of loss of material due to micro biologically induced corrosion (MIC).

Aging Management Programs:

The following AMPs are utilized to manage aging effects in the thermal regeneration system :

- Chemistry Program (B.1.4)
- Maintenance Rule Structures Program (B.1.18)

A description of these aging management programs is provided in Appendix B of the LRA. The applicant states that the effect of aging associated with the components of the thermal regeneration system will be adequately managed by these aging management programs during the period of extended operation.

Staff Evaluation

Aging Effects:

The staff reviewed the information in Section 2.3.3.23 and Tables 2.3-37, 3.3-1, and 3.3-2 in the LRA, as well as in the supplementary table and notes, entitled "Virgil C. Summer Nuclear Station Database AMR Query." During its review, the staff found that additional information was needed to complete its review.

Numerous tables included in the application list the component material and environment to which the component is exposed. However, the applicant did not provide a description of these

environments in the LRA.   By letter dated March 28, 2003, the staff issued RAI 3.3-1, pertaining to this issue of the plant- specific characteristics of the environment . The staff's evaluation of the applicant's response is documented in Section 3.3.2.5.1 of this SER, and is characterized as resolved.

In the VCSNS Database AMR Query table on the thermal regeneration system, the applicant identified only the stainless steel pipe and fittings in the sheltered environment are subject to aging effect of loss of material due to MIC. The rest of the stainless steel components in the same environment in this system are identified by the applicant as not subject to loss of material due to MIC. By letter dated March 28, 2003, the staff requested , in RAI 3.3.2.4.23-1, the applicant to explain why the conclusions are different for the same combination of material and environment.

In its response dated June 13, 2003, the applicant stated that the susceptibility to external MIC is limited locally to the area of the interface with the pertinent wall where groundwater in-leakage can occur. Only piping, process tubing, and ductwork component types pass through building penetrations. The applicant concluded that for the stainless steel components of the boron thermal regeneration system, only pipe and pipe fitting components meet these criteria.

On the basis of its review, the staff finds that the applicant's response acceptable because that the applicant has properly identified that the susceptibility to external MIC is limited locally to the area of the interface with the pertinent wall where groundwater in-leakage can occur, and that for the stainless steel components of the boron thermal regeneration system, only pipe and pipe fitting components meet these criteria. However, the staff questioned whether there are other types of water (such as water from condensation) other than ground water from intrusion present in the sheltered environment such that loss of material from MIC may become an applicable aging effect for the external surfaces of some of the applicable components of this system. The applicant was requested to provide the justification for not considering MIC from other types of water, including operating experience.

In its response dated September 2, 2003, the applicant stated that the ambient environment does not contain nutrients necessary to promote external MIC in other types of water, such as water from condensation and that because external MIC has not been found at locations other than at building penetrations, VCSNS does not specifically credit the Inspections for Mechanical Components for aging management for this aging effect; however, the applicant further stated that the Inspections for Mechanical Components will inspect for any abnormalities on external surfaces.

On the basis of its review, the staff finds that the applicant's response acceptable because the applicant has properly identified that the ambient environment does not contain nutrients necessary to promote external MIC in other types of water, such as water from condensation and that the applicant has committed to use the Inspections for Mechanical Components program to inspect for any abnormalities on external surfaces. All issues associated with this RAI 3.3.2.4.23-1, are considered resolved.

On the basis of its review of the information provided in the LRA and the additional information included in the applicant's response to the above RAIs, the staff finds that the aging effects that result from contact of the thermal regeneration system SSCs to the environments described in Tables 2.3-37, 3.3-1 and 3.3-2 are consistent with industry experience for these combinations

of materials and environments. Therefore, the staff finds that the applicant has identified the appropriate aging effects for the materials and environments associated with the components in the thermal regeneration system.

Aging Management Programs:

The applicant credited the following AMPs for managing the aging effects in the thermal regeneration system:

- Chemistry Program (Section 3.0.3.2)
- Maintenance Rule Structures Program (Section 3.0.3.4)

These AMPs are credited for managing the aging effects of components in several structures and systems and, therefore, are considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. These common AMPs are evaluated in Sections 3.0.3.2, and 3.0.3.4 of this SER.

After evaluating the applicant's AMR for each of the components in the thermal regeneration system, the staff evaluated the AMPs listed above to determine if they are appropriate for managing the identified aging effects for this system. For those components identified in Table 3.3-1 of the LRA, the staff verified that the applicant credited the AMPs recommended by the GALL report. For the components identified in LRA Table 3.3-2 , the staff verified that the applicant credited aging management programs that is appropriate for the identified aging effects.

On the basis of its review, the staff finds the applicant has credited the appropriate AMPs to manage the aging effects for the materials and environments associated with thermal regeneration system. In addition, the staff finds the associated program descriptions in the FSAR Supplement to be acceptable to satisfy 10 CFR 54.21(d).

<u>Conclusions</u>

On the basis of its review, the staff concludes that the applicant has adequately identified the aging effects, and AMPs credited for managing the aging effects, for components in thermal regeneration system, such that there is reasonable assurance that the component intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable FSAR Supplement program descriptions and concludes that the FSAR Supplement provides an adequate program description of the AMPs credited for managing aging in the thermal regeneration system to satisfy 10 CFR 54.21(d).

3.3.2.5 General AMR Issues

This section discusses the staff's evaluation of general AMR issues that are applicable to components in several auxiliary systems included in Section 3.3 of the LRA.

3.3.2.5.1 Plant Specific Environment Characteristics

Numerous tables included in the application list the component material and environment to which the component is exposed. However, the applicant did not provide a description of these environments in the LRA. It should be noted that the aging effect depends on the component material as well as the plant specific environment characteristics. A description of the specific information (such as ranges of temperature, humidity, and/or compositions etc.) related to the plant specific environment characteristics considered in the VCSNS LRA will provide the necessary environment information for the staff to perform its AMR of the components of the auxiliary systems as well as other systems in the VCSNS. By letter dated March 28, 2003, the staff requested, in RAI 3.3-1, the applicant to provide a description of the environments included in the LRA.

In its response dated June 12, 2003, the applicant stated that the internal environments for subject components, also known as the process and/or service environment, were determined by reviewing the appropriate design and operating documentation, including system design basis documents, flow diagrams, vendor technical manuals, procedures, lesson plans, etc. General temperature ranges were not established, thus temperatures for internal environments are system specific. When performing AMR’s, the temperature ranges were determined on a system-specific basis from the normal system operating ranges found on the 302 series system flow diagrams (P&ID) and are contained in the body of technical work, which is available for inspection. VCSNS is generally consistent in its internal environments with other stations and with the environments described in NUREG-1801. Internal environments for license renewal mechanical consideration for VCSNS include:

- Air-Gas (including vacuum, compressed air, compressed gases, and exhaust gases),
- Borated Water (chemically treated borated water),
- Oil (such as fuel oil, lubricating oil, synthetic oil),
- Raw Water (water taken directly from a lake, reservoir or other open external source),
- Treated Water (including filtered and chemically treated water, condensate quality water, as well as steam),
- Ventilation (includes ambient building air that is contained and/or processed through ductwork, and other ventilation equipment)

The applicant further stated that the following external environments are those to which the external portions of subject components are exposed due to the equipment location, and, therefore, require evaluation for license renewal considerations:

- Reactor Building,
- Sheltered,
- Yard,
- Underground,
- Embedded (includes significant portions of components/component types embedded in concrete and not simply portions passing through building walls).

The applicant clarified that for license renewal considerations, a “Sheltered” environment is considered to be the ambient conditions inside certain support buildings. These support buildings include the Auxiliary (AB), Control (CB), Intermediate (IB), Fuel Handling (FHB), Diesel Generator (DB), Service (SB), and Turbine (TB) Buildings. A “Sheltered” environment also includes the Fire Pump House (FPH), and Service Water Pump House (SWPH).

The ambient environment for the Reactor Building and Sheltered environments are not considered to be humidity controlled. The design average maximum temperature for buildings at VCSNS is 120 °F.

VCSNS is located well inland and is located in an area where forestry is the primary commercial activity. VCSNS does not see salt or other corrosive materials in the air from agriculture or industry. Finally the applicant stated that rainwater analyses reveal a concentration of less than 10 ppm for chlorides and sulfates.

On the basis of its review, the staff finds the applicant’s response adequate and acceptable because that the applicant has properly identified the plant-specific environment and that VCSNS does not see salt or other corrosive materials in the air from agriculture or industry. All issues associated with this RAI 3.3-1, are considered resolved.

3.3.2.5.2 Carbon Steel Components in Sheltered Environment

This general AMR issue concerns aging mechanisms related to the aging effect of loss of materials in sheltered environment for carbon steel components in the auxiliary systems described below.

For carbon steel components exposed to external environments of moist air such as sheltered environment, the GALL report identified loss of material due to general, pitting, crevice corrosion and MIC as an aging effect. But for carbon steel components in the Gaseous Waste Processing System the applicant stated, in the table entitled “Virgil C. Summer Nuclear Station Database AMR Query” that for carbon steel in a sheltered environment, the aging effect of loss of material is due only to general corrosion. However, in the AMR Query Note A-W.G.-C, the applicant stated that MIC is also an applicable aging effect for carbon steel in a sheltered environment. The applicant is requested to clarify this discrepancy. Also for carbon steel components in the Instrument Air Supply System no aging effect is identified by the applicant for carbon steel components exposed to sheltered environment. The applicant is requested to justify why loss of material due to general, pitting, crevice corrosion or MIC is not an applicable aging effect for the carbon steel components exposed to sheltered environment.

By letter dated March 28, 2003, the staff requested, in RAI 3.3-2, the applicant to provide a clarification of the issues highlighted above on the aging mechanisms related to the aging effect of loss of materials in sheltered environment for carbon steel components in the auxiliary systems discussed above.

In its response dated June 12, 2003, the applicant stated that plant operating experience has identified the accumulation of microbiological organisms on the external surfaces of some piping components at building wall penetrations as a result of groundwater intrusion effects. The structural design of the plant is such that any groundwater intrusion in the sheltered environment is directed to sumps and away from equipment within the scope of license renewal. It is the residual presence of microbiological organisms that is of concern for subject mechanical components.

The applicant further stated that the VCSNS Final Safety Analysis Report [FSAR] identifies a groundwater elevation of 420' +/- 3'. Certain structures, such as the Service Water Pumphouse, are potentially exposed to a ground water level of 425'. As such, piping, process

tubing, and ductwork component types were conservatively considered to be susceptible to external MIC if they either enter a building from outside or pass between buildings included in the sheltered environment below the 425’ elevation. Additionally, the susceptibility to external MIC was limited locally to the area of the interface with the pertinent wall. For building fire seal penetrations in the sheltered environment, the management of aging of the pertinent structural commodities precludes the accumulation of the necessary microbiological organisms, and thus MIC, on interfacing mechanical component types.

Therefore, the applicant concluded that loss of material due to MIC has been identified as an aging effect requiring system specific evaluation in sheltered environments for piping, process tubing, and ductwork that pass between pertinent buildings through a non fire seal penetration or enters the building from outside below the 425’ elevation. The applicant also stated that the building penetrations are inspected as part of the Maintenance Rule Structures Program (Application Section B.1.18). The VCSNS Corrective Action Program would be used in the disposition of any groundwater in-leakage and resulting degradation.

Moreover, the applicant stated that crevice and pitting corrosion are not considered to be aging effects for external surfaces because the ambient environment does contain contaminants of sufficient quantity to concentrate on external surfaces such that pitting or crevice corrosion would occur. Rainwater analyses reveal a concentration of less than 10 ppm for chlorides and sulfates. Finally, the applicant stated that general corrosion is an aging effect for external surfaces in sheltered environments and that it is managed by the Inspections for Mechanical Components.

On the basis of its review of the above information, the staff requested the applicant to clarify whether there are other types of water (such as water from condensation) other than ground water from intrusion present in the sheltered environment such that loss of material from MIC may become an applicable aging effect for the external surfaces of some of the applicable components of this system. The applicant was also requested to provide the justification for not considering MIC from other types of water, including operating experience.

In its response dated September 2,2003, the applicant stated that the ambient environment does not contain nutrients necessary to promote external MIC in other types of water, such as water from condensation and that because external MIC has not been found at locations other than at building penetrations, VCSNS does not specifically credit the Inspections for Mechanical Components for aging management for this aging effect; however, the applicant further stated that the Inspections for Mechanical Components will inspect for any abnormalities on external surfaces.

On the basis of its review, the staff finds the applicant’s response adequate and acceptable because the applicant has demonstrated that 1) loss of material due to MIC has been identified as an aging effect requiring system specific evaluation in sheltered environments for piping, process tubing, and ductwork that pass between pertinent buildings through a non fire seal penetration or enters the building from outside below the 425' elevation, 2) the ambient environment does not contain contaminants of sufficient quantity to concentrate on external surfaces such that pitting or crevice corrosion would occur, and 3) the ambient environment does not contain nutrients necessary to promote external MIC in other types of water, such as water from condensation. In addition, the applicant will use the Inspections for Mechanical

Components program to inspect for any abnormalities on external surfaces. All issues associated with this RAI 3.3-2, are resolved.

3.3.2.5.3 Stainless Steel Components in Sheltered Environment

This general AMR issue concerns the susceptibility to aging effects for stainless steel components in ambient environment in the auxiliary systems described below.

Stainless steel components in ambient environment may be subject to aging effect of loss of material due to pitting, crevice corrosion and MIC. In the VCSNS Database AMR Query table, the applicant identified no aging effects for stainless steel pipe and fittings, tube and tube fittings, and valves (body only) in the reactor building and sheltered environments because of the presence of insignificant concentration of contaminants in these environments. The applicant is requested to provide the basis for determining significant concentration of contaminants and the verification/inspection activities on susceptible locations to justify this basis. These issues are applicable to stainless steel components in ambient environment in the Liquid Waste Processing System, Nuclear & Non-nuclear Plant Drains, Roof Drains System, and the Station Service Air System.

By letter dated March 28, 2003, the staff requested, in RAI 3.3-3, the applicant to provide a clarification of the issues highlighted above on the aging mechanisms related to the aging effect of loss of materials in sheltered environment for stainless steel components in the auxiliary systems discussed above.

In its response dated June 13, 2003, the applicant stated that plant operating experience has identified the accumulation of microbiological organisms on the external surfaces of some piping components at building wall penetrations as a result of groundwater intrusion effects. The structural design of the plant is such that any groundwater intrusion in the sheltered environment is directed to sumps and away from equipment within the scope of license renewal. It is the residual presence of microbiological organisms that is of concern for subject mechanical components.

The applicant further stated that the VCSNS Final Safety Analysis Report [FSAR] identifies a groundwater elevation of 420’ +/- 3’. Certain structures, such as the service water pumphouse, are potentially exposed to a ground water level of 425’. As such, piping, process tubing, and ductwork component types were conservatively considered to be susceptible to external MIC if they either enter a building from outside or pass between buildings included in the sheltered environment below the 425’ elevation. Additionally, the susceptibility to external MIC was limited locally to the area of the interface with the pertinent wall. For building fire seal penetrations in the sheltered environment, the management of aging of the pertinent structural commodities precludes the accumulation of the necessary microbiological organisms, and thus MIC, on interfacing mechanical component types.

Therefore, the applicant concluded that loss of material due to MIC has been identified as an aging effect requiring system specific evaluation in sheltered environments for piping, process tubing, and ductwork that pass between pertinent buildings through a non fire seal penetration or enters the building from outside below the 425’ elevation.

In addition, the applicant stated that building penetrations are inspected as part of the Maintenance Rule Structures Program (Application Section B.1.18). The VCSNS Corrective Actions Program would disposition any groundwater in-leakage and resulting degradation. VCSNS is located well inland and is located in an area where forestry is the prime commercial activity. VCSNS does not see salt or other corrosive materials in the air from agriculture or industry. Crevice and pitting corrosion are not considered to be aging effects for external surfaces because the ambient environment does not contain contaminants of sufficient quantity to concentrate on external surfaces such that pitting or crevice corrosion would occur. Finally, the applicant stated that rainwater analyses reveal a concentration of less than 10 ppm for chlorides and sulfates.

On the basis of its review of the above information, the staff requested the applicant to clarify whether there are other types of water (such as water from condensation) other than ground water from intrusion present in the sheltered environment such that loss of material from MIC may become an applicable aging effect for the external surfaces of some of the applicable components of this system. The applicant was also requested to provide the justification for not considering MIC from other types of water, including operating experience.

In its response dated September 2, 2003, the applicant stated that the ambient environment does not contain nutrients necessary to promote external MIC in other types of water, such as water from condensation and that because external MIC has not been found at locations other than at building penetrations, VCSNS does not specifically credit the Inspections for Mechanical Components for aging management for this aging effect; however, the applicant further stated that the Inspections for Mechanical Components will inspect for any abnormalities on external surfaces.

On the basis of its review, the staff finds the applicant's response adequate and acceptable because the applicant has demonstrated that 1) loss of material due to MIC has been identified as an aging effect requiring system specific evaluation in sheltered environments for piping, process tubing, and ductwork that pass between pertinent buildings through a non fire seal penetration or enters the building from outside below the 425' elevation, 2) the ambient environment does not contain contaminants of sufficient quantity to concentrate on external surfaces such that pitting or crevice corrosion would occur, and 3) the ambient environment does not contain nutrients necessary to promote external MIC in other types of water, such as water from condensation. In addition, the applicant will use the Inspections for Mechanical Components program to inspect for any abnormalities on external surfaces. All issues associated with this RAI 3.3-3, are considered resolved.

3.4 Steam and Power Conversion Systems

This section addresses the aging management of the components of the steam and power conversion (SPC) systems group. The systems that make up the SPC systems group are described in the following SER sections:

- auxiliary boiler steam and feedwater (2.3.4.1)
- condensate (2.3.4.2)
- emergency feedwater (2.3.4.3)
- extraction steam (2.3.4.4)

- feedwater (2.3.4.5)
- gland sealing steam (2.3.4.6)
- main steam (2.3.4.7)
- main steam dump (2.3.4.8)
- main turbine and turbine accessories (2.3.4.9)
- turbine cycle sampling (2.3.4.10)
- steam generator blowdown (2.3.4.11)
- electro-hydraulic control (2.3.4.12)

As discussed in Section 3.0.1 of this SER, the components requiring aging management in each of these SPC systems are included in one of two LRA tables. LRA Table 3.4-1 consists of SPC systems components that are evaluated in the GALL Report, as well as SPC systems components that were not evaluated in the GALL Report, but which the applicant has determined can be managed using a GALL AMR and associated AMP. LRA Table 3.4-2 consists of SPC systems components that are not evaluated in the GALL Report.

3.4.1 Summary of Technical Information in the Application

In LRA Section 3.4, the applicant described its AMRs for the SPC systems group at VCSNS. The description of the systems that comprise the SPC systems group can be found in LRA Section 2.3.4. The passive, long-lived components in these systems that are subject to an AMR are identified in LRA Tables 2.3-38, 2.3-39, 2.3-40, 2.3-41, 2.3-42, 2.3-43, 2.3-44, 2.3-45, 2.3-46, and 2.3-47.

The applicant's AMRs included an evaluation of plant-specific and industry operating experience. The plant-specific evaluation included reviews of its Corrective Action Program, licensee event reports, and Maintenance Rule Data Base, as well as interviews with systems engineers. An evaluation of industry operating experience published since the effective date of the GALL Report was performed to identify any additional aging effect requiring management. The results of these reviews concluded that no aging effects requiring management were identified beyond those identified using the AMR methodology described in Section 3.4.2.1 of the LRA. The applicant's ongoing review of plant-specific and industry-wide operating experience is conducted in accordance with the plant's Operating Experience Program.

3.4.2 Staff Evaluation

In Section 3.4 of the LRA, the applicant described its AMR for the SPC systems at VCSNS. The staff reviewed Section 3.4 to determine whether the applicant provided sufficient information to demonstrate that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB throughout the period of extended operation, in accordance with the requirements of 10 CFR 54.21(a)(3), for the SPC systems components that are determined to be within the scope of license renewal and subject to an AMR.

The systems that make up the SPC systems group are (1) auxiliary boiler steam and feedwater, (2) condensate, (3) emergency feedwater, (4) extraction steam, (5) feedwater, (6) gland sealing steam, (7) main steam, (8) main steam dump, (9) main turbine and turbine accessories, (10) turbine cycle sampling, (11) steam generator blowdown, and (12) electro-hydraulic control.

The applicant referenced the GALL Report in its AMR. The staff has previously evaluated the adequacy of the aging management of SPC systems components for license renewal as documented in the GALL Report. Thus, the staff did not repeat its review of the matters described in the GALL Report, except to ensure that the material presented in the LRA was applicable and to verify that the applicant had identified the appropriate programs as described and evaluated in the GALL Report. The staff evaluated those aging management issues recommended for further evaluation in the GALL Report. The staff also reviewed aging management information submitted by the applicant that was different from that in the GALL Report or was not addressed in the GALL Report.

Table 3.4-1 below provides a summary of the staff's evaluation of components, aging effects/mechanisms, and AMPs listed in LRA Section 3.4 that are addressed in the GALL Report.

Table 3.4-1: Staff Evaluation for VCSNS Steam and Power Conversion Systems Components Evaluated in the GALL Report

Component Group	Aging Effect/Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
(1) Piping and fittings in main feedwater line, steam line, and AFW piping (PWR only)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	TLAA in LRA Section 4.3	GALL recommends further evaluation (See staff evaluation in Section 3.4.2.2.1).
(2) Piping and fittings, valve bodies and bonnets, pump casings, tanks, tubes, tubesheets, channel head and shell (except main steam system)	Loss of material due to general (carbon steel only), pitting, and crevice corrosion	Water Chemistry and One-Time Inspection	Chemistry Program (includes one-time inspection)	GALL recommends further evaluation (See staff evaluation in Section 3.4.2.2.2).
(3) AFW piping	Loss of material due to general, pitting, and crevice corrosion, MIC, and biofouling	Plant-specific	Service Water System Reliability and In-Service Testing Program	GALL recommends further evaluation (See staff evaluation in Section 3.4.2.2.3).
(4) Oil coolers in AFW system (lubricating oil side possibly contaminated with water)	Loss of material due to general (carbon steel only), pitting, and crevice corrosion and MIC	Plant-specific	Chemistry Program	GALL recommends further evaluation. (See staff evaluation in Section 3.4.2.2.5).

Table 3.4-1: Staff Evaluation for VCSNS Steam and Power Conversion Systems Components Evaluated in the GALL Report				
Component Group	**Aging Effect/Mechanism**	**AMP in GALL Report**	**AMP in LRA**	**Staff Evaluation**
(5) External surface of carbon steel components	Loss of material due to general corrosion	Plant-specific	Inspection of Mechanical Components Program and Maintenance Rule Structures Program	GALL recommends further evaluation (See staff evaluation in Section 3.4.2.2.4.)
(6) Carbon steel piping and valve bodies	Wall thinning due to FAC	Flow-accelerated corrosion	Flow-Accelerated Corrosion Monitoring Program	Consistent with GALL (See staff evaluation in Section 3.4.2.1).
(7) Carbon steel piping and valve bodies in main steam system	Loss of material due to pitting and crevice corrosion	Water chemistry	Chemistry Program	Consistent with GALL (See staff evaluation in Section 3.4.2.1).
(8) Closure bolting in high-pressure or high-temperature systems	Loss of material due to general corrosion; crack initiation and growth due to cyclic loading and/or SCC	Bolting Integrity	Inspection of Mechanical Components Program	The Inspection of Mechanical Components Program manages aging effects for SPC Systems bolting (See staff evaluation in Section 3.0.3.7).
(9) Heat exchangers and coolers/condensers serviced by open-cycle cooling water	Loss of material due to general (carbon steel only), pitting, and crevice corrosion, MIC, and biofouling; buildup of deposit due to biofouling	Open-Cycle Cooling Water System	Not applicable	Open-cycle cooling water system as described by NUREG-1801 is not used in any SPC systems at VCSNS.
(10) Heat exchangers and coolers/condensers serviced by closed-cycle cooling water	Loss of material due to general (carbon steel only), pitting, and crevice corrosion	Closed-Cycle Cooling Water System	Not applicable	Closed-cycle cooling water system as described by NUREG-1801 is not used in any SPC systems at VCSNS.

Table 3.4-1: Staff Evaluation for VCSNS Steam and Power Conversion Systems Components Evaluated in the GALL Report				
Component Group	**Aging Effect/Mechanism**	**AMP in GALL Report**	**AMP in LRA**	**Staff Evaluation**
(11) External surface of above ground condensate storage tank	Loss of material due to general (carbon steel only), pitting, and crevice corrosion	Above-Ground Carbon Steel Tanks	Not applicable	See staff evaluation in Section 3.4.2.4.2.
(12) External surface of buried condensate storage tank and AFW piping	Loss of material due to general, pitting, and crevice corrosion and MIC	Buried Piping and Tanks Surveillance or Buried Piping and Tanks Inspection	Buried Piping and Tanks Inspection Program	GALL recommends further evaluation (See staff evaluation in Section 3.4.2.2.5).
(13) External surface of carbon steel components	Loss of material due to boric acid corrosion	Boric Acid Corrosion	Boric Acid Corrosion Surveillances Program	Consistent with GALL (See staff evaluation in Section 3.4.2.1).

3.4.2.1 Aging Management Evaluations in the GALL Report That Are Relied On For License Renewal, Which Do Not Require Further Evaluation

For component groups evaluated in the GALL Report for which the applicant has claimed consistency with GALL, and for which the GALL Report does not recommend further evaluation, the staff sampled components in these groups to determine whether the plant-specific components contained in these GALL Report component groups were bounded by the GALL evaluation. The staff also sampled component groups to determine whether the applicant had properly identified those component groups in the GALL Report that were not applicable to its plant. The staff also identified three areas where additional information or clarification was needed. The staff's evaluation of the applicant's responses to those RAIs is included in Sections 3.4.2.4.2 (RAI 3.4-13), 3.4.2.4.3 (RAI 3.4-12), and 3.4.2.4.13 (RAI 3.4-10) of this SER.

Table 3.4-1 of this SER contains a summary of the AMPs for SPC systems evaluated in Chapter VIII of the GALL Report. The GALL Report identifies specific component, material, environment, and aging effect/mechanism combinations that are managed by the GALL Report AMPs; therefore, VCSNS AMPs that are consistent with the GALL Report are only applicable to these specific material, environment, and aging effect/mechanism combinations. In addition to those component, material, environment, and aging effect/mechanism identified in the GALL Report, the applicant identified the following materials and aging mechanisms as being managed by the VCSNS AMPs that are consistent with the GALL Report AMPs:

- In Table 3.4-1, Item 6 of the SER, the applicant identified low-alloy steel components as being managed for wall thinning by the Flow-Accelerated Corrosion Program.

- In Table 3.4-1, Item 7 of the SER, the applicant identified the aging mechanisms of general corrosion and galvanic corrosion as being managed for loss of material by the Chemistry Program.

- In Table 3.4-1, Item 13 of the SER, the applicant identified cast iron as being managed for loss of material by the Boric Acid Corrosion Surveillances Program.

The staff finds the materials and aging mechanisms identified above as being adequately managed by GALL Report AMPs; therefore the staff finds that the applicant's aging management of these materials and aging mechanisms is acceptable.

On the basis of its review, the staff has verified the applicant's claim of consistency with the GALL report. The staff finds that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.2 Aging Management Evaluations in the GALL Report That Are Relied On For License Renewal, For Which GALL Recommends Further Evaluation

For component groups evaluated in the GALL Report for which the applicant has claimed consistency with GALL, and for which the GALL Report recommends further evaluation, the staff reviewed the applicant's evaluation to determine whether it adequately addressed the issues for which the GALL Report recommended further evaluation. In addition, the staff sampled components in these groups during the review to determine whether the plant-specific components contained in these GALL Report component groups were bounded by the GALL evaluation.

The GALL Report indicates that further evaluation should be performed for the aging effects discussed in the following sections:

3.4.2.2.1 Cumulative Fatigue Damage

Fatigue is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). The staff reviewed the evaluation of this TLAA in Section 4.3 of this SER, following the guidance in Section 4.3 of the SRP-LR. The staff issued RAI 3.4-2 and RAI 3.4-3, to clarify aging management of SPC systems components for fatigue.

In Tables 2.3-38 through 2.3-47 of the LRA, the applicant does not identify any SPC systems components that are managed for cumulative fatigue. The GALL Report recommends aging management of cumulative fatigue for piping and fittings in the main steam, feedwater, and auxiliary feedwater systems. The staff issued RAI 3.4-2, requesting the applicant to explain why Tables 2.3-38 thru 2.3-47 do not identify any SPC systems components that are managed for cumulative fatigue.

In its response by letter dated June 12, 2003, the applicant stated that cumulative fatigue is considered to be a TLAA. It is discussed in Section 4 of the LRA entitled, "Time-Limiting Aging Analysis." The staff finds the applicant's response to RAI 3.4-2, reasonable and acceptable because it explains that fatigue for SPC systems is discussed in Section 4 of the LRA.

In Table 3.4-1, Item 1 of the LRA, the applicant identified aging management for cumulative fatigue damage for piping and fitting in the main feedwater line, the steam line, and for AFW piping. In the "discussion" column for this item, the LRA states, "see Section 4.3.2 [of the LRA] for the TLAA discussion of Class 2 and 3 piping." The "discussion" column does not state if the applicant's TLAA is consistent with the GALL Report TLAA program. For the SPC systems piping, the GALL Report recommends an evaluation of allowable stress levels based on the number of anticipated thermal cycles, as described in SRP-LR, Section 4.3.1.1.2. The staff issued RAI 3.4-3, requesting the applicant to explain if thermal cycle evaluation is performed as described in SRP-LR, Section 4.3.1.1.2, for the main feedwater line, the steam line, and for AFW piping, and if the applicant's TLAA program is consistent with the GALL Report. If the programs were not consistent, the applicant was requested to explain any differences.

In its response by letter dated June 12, 2003, the applicant stated that for the non-Class 1 components, VCSNS utilized the method described in Section 4.3.1.1.2 of SRP-LR to evaluate fatigue in the SPC systems as a TLAA. The methodology used at VCSNS includes any system or portion of system with operating temperatures greater than 220 °F. The flow diagrams of non-Class 1 systems in scope for license renewal were reviewed for operating temperatures. The screened-in portions of these systems meeting the temperature threshold were further reviewed to determine the frequency with which the thermal cycles occurred. The in-scope SPC systems that meet the temperature threshold include the auxiliary boiler steam and feedwater system, the steam generator blowdown system, the extraction steam system, the feedwater system, the main steam dump system, the main steam system, and the turbine cycle sampling system. For all of these SPC systems, the number of thermal cycles is related to the heat-up and cool-down of the plant (steam and primary), which ideally occurs once a cycle (18 months). The applicant indicated that if the cycling is conservatively assumed to occur once a month for 60 years, then the total thermal cycles would only be 720, which is approximately one-tenth of the allowed 7000 cycles.

The staff finds the applicant's response to RAI 3.4-2, reasonable and acceptable because it explains that fatigue for SPC systems is evaluated by VCSNS in accordance with Section 4.3.1.1.2 of SRP-LR.

3.4.2.2.2 Loss of Material Due to General, Pitting, and Crevice Corrosion

The SRP-LR recommends further evaluation of programs to manage loss of material due to general, pitting, and crevice corrosion of carbon steel piping and fittings, valve bodies and bonnets, pump casings, pump suction and discharge lines, tanks, tubesheets, channel heads, and shells (except for main steam system components), and for loss of material due to crevice and pitting corrosion for stainless steel tanks and heat exchanger/cooler tubes. The GALL Report Water Chemistry Program relies on monitoring and control of water chemistry based on the guidelines in EPRI TR-102134, "PWR Secondary Water Chemistry Guideline—Revision 3," May 1993, for secondary water chemistry in PWRs, to manage the effect of loss of material due to general (carbon steel only), pitting, or crevice corrosion. However, corrosion may occur at locations of stagnant flow conditions. Therefore, the GALL Report recommends that the effectiveness of the applicant's Chemistry Program be verified to ensure that corrosion is not occurring.

In Table 3.4-1, Item 2 of the LRA, the applicant stated that various components will be managed for the aging effect of loss of material due to general (carbon steel only), pitting, and

crevice corrosion using the applicant's Chemistry Program. However, the applicant did not believe that a one-time inspection was warranted to verify that corrosion was not occurring for components in this group, except for the condensate storage tank. The LRA further states that a review of operating experience confirms the effectiveness of the Chemistry Program for treated water to manage aging effects when continued into the period of extended operation. The GALL Report recommends that a one-time inspection be performed to address concerns for the potential long incubation period for certain aging effects on SCs. There are cases where either (1) an aging effect is not expected to occur, but there are insufficient data to completely rule it out, or (2) an aging effect is expected to progress very slowly. For these cases, there needs to be confirmation that either the aging effect is indeed not occurring, or the aging effect is occurring so slowly as not to affect the component or structure intended function. A one-time inspection of select components and susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the components intended function will be maintained during the period of extended operation. The one-time inspection should be performed late in the current operating period to ensure that the aging effects will not affect the component intended function during the period of extended operation. The staff issued RAI 3.4-4, requesting the applicant to explain how operating experience will confirm that these aging effects will not occur during the period of extended operation or to commit to performing a one-time inspection of components based on the severity of conditions, time of service, and lowest design margin as recommended by the GALL Report AMP, XI.M32, "One-Time Inspection." This RAI also applies to the valves in Table 3.4-2, Item 5. The GALL Report does not recommend a one-time inspection for main steam system piping. Therefore, a one-time inspection is not necessary to verify the effectiveness of the Water Chemistry Program for the main steam system components listed in LRA Table 2.3-44.

In its response by letters dated June 12, 2003 and September 2, 2003, the applicant stated that one-time inspections will be performed in low flow areas prior to the period of extended operation to verify the effectiveness of the Chemistry Program to manage aging in various chemistry regimes of systems within the scope for license renewal. These one-time inspections will be part of the Chemistry Program as described by license renewal. For the applicable SPC systems, the chemistry regimes are found in the feedwater (FW) system, the condensate (CO) system, and the emergency feedwater (EF) system. The FW, CO, and EF systems have the same chemistry regime; therefore, results from an inspection on one system should be representative of the other systems. Engineering personnel will perform visual examinations in low flow areas. Engineering personnel familiar with the system and the system operating history will determine these inspection sites. Any abnormality found by these inspections will be determined by engineering evaluation and addressed in the Corrective Action Program. Quality Control personnel would perform further inspections required by the Corrective Action Program. Qualifications of the Quality Control inspectors are in accordance with ASME Section XI as described in paragraph IWA-2300.

The staff finds the applicant's response to RAI 3.4-4, reasonable and acceptable because it provides an explanation that one-time inspections will be adequately performed to verify the effectiveness of the Chemistry Program.

In Table 3.4-1, Item 2 of the LRA, the applicant identified the following differences between the GALL Report Water Chemistry Program and the VCSNS Chemistry Program and has proposed the Chemistry Program as the AMP for managing these additional aging effects, materials, and components:

- The VCSNS Above Ground Tank Inspections program will perform inspections of the condensate storage tank interior to verify the effectiveness of the Chemistry Program.

- In addition to the aging mechanisms identified in the GALL Report, VCSNS credits the Chemistry Program for managing galvanic corrosion, SCC, and the corrosive effects of alternate wetting and drying.

- In addition to the materials identified in the GALL Report, VCSNS credits the Chemistry Program for managing aging effects for low-alloy steel and nickel based metal.

- In addition to the components identified in the GALL Report, VCSNS includes similar components from the nuclear sampling system in a treated water environment.

The staff finds the components, materials, and aging mechanisms identified above as being adequately managed by the VCSNS Chemistry Program; therefore the staff finds that the applicant's aging management of these components, materials, and aging mechanisms is acceptable.

On the basis of its review, the staff finds that the applicant appropriately evaluated AMR results involving management of the loss of material due to general, pitting, and crevice corrosion for components in the SPC systems, as recommended in the GALL Report. Since the applicant's AMR results are otherwise consistent with the GALL report, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.2.3 Loss of Material Due to General, Pitting, and Crevice Corrosion, Microbiologically Influenced Corrosion, and Biofouling

The SRP-LR recommends further evaluation of programs to manage loss of material due to general corrosion, pitting, and crevice corrosion, MIC, and biofouling for carbon steel piping and fittings for untreated water from the backup water supply in the auxiliary feedwater system. The staff reviewed the applicant's proposed program to ensure that an adequate program will be in place for the management of this aging effect.

Loss of material due to general corrosion, pitting and crevice corrosion, MIC, and biofouling could occur in carbon steel piping and fittings for untreated water from the backup water supply in the auxiliary feedwater system. In Table 3.4-1, Item 3 of the LRA, the applicant does not identify aging management of raw water exposure to AFW piping. In the "discussion" column, the LRA states that:

> AFW piping at VCSNS is not exposed to untreated water. The service water system provides emergency backup to the emergency feedwater system through automatic isolation valves that normally provide boundary isolation between the treated water of the emergency feedwater system and the untreated water of the service water system.

The staff issued RAI 3.4-6, requesting verification that the AFW piping has not been exposed to raw water. If any portion of the auxiliary feedwater system requires aging management due to

exposure to raw water, the applicant was requested to list the components and describe how aging will be managed.

In its response by letter dated June 12, 2003, the applicant stated that although there are automatic isolation valves that isolate the service water system from the emergency feedwater system, there is a section of emergency feedwater system piping (carbon steel) downstream of these automatic isolation valves that is filled from the service water system. Therefore, a portion of the emergency feedwater system is indeed exposed to a raw water environment. This piping is inspected under the activities described by the Service Water System Reliability and In-Service Testing Program and will continue to effectively manage the aging effects for this section of piping for the period of extended operation.

The staff finds the applicant's response to RAI 3.4-6, reasonable and acceptable because it provides an explanation that a section of the emergency feedwater system piping exposed to a raw water environment is managed for aging effects by the Service Water System Reliability and In-Service Testing Program.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results involving management of the loss of material due to general corrosion, pitting and crevice corrosion, MIC, and biofouling for auxiliary feedwater system components exposed to a raw water environment, as recommended in the GALL Report. Since the applicant's AMR results are otherwise consistent with the GALL report, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.2.4 Loss of Material Due to General Corrosion

The GALL Report recommends further evaluation of programs to manage loss of material due to general corrosion for external surfaces of all carbon SCs, including closure bolting, exposed to operating temperatures less than 212 °F. Such corrosion may be due to air, moisture, or humidity. The applicant credits the Inspections of Mechanical Components Program to manage corrosion in ambient, moist air for loss of material due to general corrosion and galvanic corrosion. The applicant credits the Maintenance Rule Structures Program to manage loss of material due to MIC on external surfaces in contact with ground water. The staff reviewed the applicant's Inspections of Mechanical Components Program in Section 3.0.3.7 of this SER and the Maintenance Rule Structures Program in Section 3.0.3.4 of this SER to ensure that these programs adequately manage this aging effect.

In addition to carbon steel components identified in Table 3.4-1 of the LRA, the applicant included low-alloy steel and cast iron components to be managed for loss of material on external surfaces by the Inspections of Mechanical Components Program and the Maintenance Rule Structures Program. The staff considers it acceptable for the applicant to credit these programs to manage low-alloy steel and cast iron components for loss of material on external surfaces.

On the basis of its review, the staff finds that the applicant appropriately evaluated AMR results involving management of the loss of material due to general corrosion for components in the SPC systems, as recommended in the GALL Report. Since the applicant's AMR results are

otherwise consistent with the GALL report, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.2.5 Loss of Material Due to General, Pitting, and Crevice Corrosion and Microbiologically Influenced Corrosion

The GALL Report recommends further evaluation of programs to manage the loss of material due to general corrosion (carbon steel only), pitting and crevice corrosion, and MIC for stainless steel and carbon steel shells, tubes, and tubesheets within the bearing oil coolers (for steam turbine pumps) in the auxiliary feedwater system. Such corrosion may be due to water contamination that affects the quality of the lubricating oil in the bearing oil coolers. The staff reviewed the applicant’s proposed program to ensure that an adequate program will be in place for the management of the aging effect.

In Table 3.4-1, Item 4 of the LRA, the applicant stated that aging management review for the AFW system pump lubricating oil coolers determined that water and contaminates will not intrude into the oil environments for these components. The staff's position is that an environment of lubricating oil contaminated with water may cause loss of material of carbon or stainless steel heat exchanger components due to general corrosion (carbon steel only), pitting, and crevice corrosion, and MIC. Therefore, the AFW system pump lubricating oil coolers have the potential of being contaminated with water. The staff issued RAI 3.4-7, requesting the applicant to explain why water and contaminates will not intrude into the oil environments for these heat exchangers and why oil samples are not credited to ensure water does not contaminate the lube oil. This RAI also applies to the heat exchangers in Table 3.4-2, Item 3.

In its response by letters dated June 12, 2003 and September 2, 2003, the applicant stated that the turbine driven emergency feedwater pump oil cooler is cooled by emergency feedwater from the discharge of the pump, such that the oil is cooled only when the pump is running. The oil temperature is therefore at ambient temperature when the pump is in its normal standby condition. Because the oil is always at or above (when the pump is running) ambient temperature, moisture does not condense out of the oil to pool in the reservoir. A review of the operating history for this reservoir reveals no degradation. This line of reasoning is proven by the history of the charging/safety injection pump oil reservoirs. When cooling was supplied continuously to the reservoir coolers, water was regularly found in the oil. When this was changed so that cooling was supplied only when the pump was running and stopped when the pump was in standby, water was no longer found in the reservoir. To verify water is not accumulating in the coolers, the applicant stated that the Chemistry Program at VCSNS samples the lubricating oil of the turbine driven emergency feedwater pump on a regularly scheduled basis. The maximum limit for water is 0.1%. The results of these samples are typically less than .01%. The maximum concentration found was 0.02%. These concentrations are considered to be trace amounts; therefore, water will not pool on any surfaces. Any unexpected loss of material would be identified by the oil analysis program.

The staff finds the applicant’s response to RAI 3.4-7 reasonable and acceptable because it provides an explanation that loss of material due to water contamination is adequately managed for the lube oil side of the turbine driven emergency feedwater pump oil cooler.

On the basis of its review, the staff finds that the applicant appropriately evaluated AMR results involving management of the loss of material due to general, pitting, and crevice corrosion, and MIC for AFW system oil coolers in the SPC systems, as recommended in the GALL Report. Since the applicant's AMR results are other wise consistent with the GALL report, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The GALL Report recommends further evaluation of programs to manage loss of material due to general corrosion, pitting and crevice corrosion, and MIC of underground piping and fittings in the auxiliary feedwater system and underground condensate storage tank in the condensate system. In LRA Table 3.4-1, Item 12, the applicant stated that the condensate storage tank is above ground; however, there is underground piping in the auxiliary feedwater system. VCSNS credits the Buried Piping and Tanks Inspection Program for managing the aging for theI underground AFW piping. The Buried Piping and Tanks inspection Program relies on industry practice, frequency of pipe excavation, and operating experience to manage the effects of loss of material from general corrosion, pitting and crevice corrosion, and MIC. See Section 3.0.3.6 of this SER for the staff evaluation of the Buried Piping and Tanks Inspection Program.

On the basis of its review, the staff finds that the applicant appropriately evaluated AMR results involving management of the loss of material due to general, pitting, and crevice corrosion and MIC for buried AFW components in the SPC systems, as recommended in the GALL Report. Since the applicant's AMR results are otherwise consistent with the GALL report, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.3 Aging Management Programs for Steam and Power Conversion Systems Components

In SER Section 3.4.2.1, the staff evaluated the applicant's conformance with the aging management recommended by the GALL Report for the SPC systems. In SER Section 3.4.2.2, the staff reviewed the applicant's evaluation of the issues for which the GALL Report recommends further evaluation. In this SER section, the staff presents its evaluation of the programs used by the applicant to manage the aging of the components in the SPC systems.

The applicant credits 10 AMPs to manage the aging effects associated with components in the SPC systems. Two of the AMPs are credited with managing aging for components in the SPC systems groups (plant-specific AMPs). Eight of the AMPs are credited with managing aging for components in other system groups (common AMPs). The staff's evaluation of the plant-specific AMPs credited with managing aging in SPC systems components is provided in Sections 3.4.2.3.1 and 3.4.2.3.2 of this SER. The staff's evaluation of the common AMPs credited with managing aging in SPC systems components is provided in Section 3.0.3 of this SER. The plant-specific and common AMPs are listed below:

- Flow-Accelerated Corrosion Monitoring Program (plant-specific) (3.4.2.3.1)
- Preventive Maintenance Activities — Terry Turbine Program (plant-specific) (3.4.2.3.2)
- Boric Acid Corrosion Surveillances Program (3.0.3.1)
- Chemistry Program (3.0.3.2)
- Maintenance Rule Structures Program (3.0.3.4)

- Above Ground Tank Inspections Program (3.0.3.5)
- Buried Pipe and Tanks Inspection Program (3.0.3.6)
- Inspections for Mechanical Components Program (3.0.3.7)
- Heat Exchanger Inspections Program (3.0.3.8)
- Service Water System Reliability and In-Service Testing Program (3.3.2.3.1)

On the basis of its review, the staff finds that the applicant has properly identified the applicable aging effects and AMPs for the components in the SPC systems at VCSNS, and that the components in the VCSNS SPC systems were correctly evaluated in the applicant's AMR and will be adequately managed during the period of extended operation.

3.4.2.3.1 Flow-Accelerated Corrosion Monitoring Program

The Flow-Accelerated Corrosion (FAC) Monitoring Program is described in Section B.1.6 of Appendix B to the LRA. The LRA credits the Flow-Accelerated Corrosion Monitoring Program with detecting and managing loss of material in components susceptible to FAC in the steam and power conversion system extractive steam, feedwater, gland seal steam, main steam, main steam dump, and steam generator blowdown systems at the VCSNS. The staff reviewed the LRA to determine whether the applicant had demonstrated that the Flow-Accelerated Corrosion Monitoring Program will adequately manage the applicable aging effects for the components that credit this program during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Summary of Technical Information in the Application

The applicant's Flow-Accelerated Corrosion Monitoring Program is discussed in LRA Section B.1.6, "Flow-Accelerated Corrosion Monitoring Program." The applicant states that the program is consistent with GALL AMP XI.M17, "Flow-Accelerated Corrosion," with no exceptions or enhancements specified in the LRA. The LRA credits the FAC Monitoring Program with detecting and managing loss of material in components susceptible to flow-accelerated corrosion in the steam and power conversion system (SPCS) extractive steam, feedwater, gland seal steam, main steam, main steam dump, and steam generator blowdown systems. In the FSAR supplement 18.2.17 of the LRA, the applicant stated that this program is intended to manage FAC by combining the following elements: NUREG guidelines, predictive analysis, inspections, industry experience, station information gathering and communication, engineering judgment, and long-term mitigative strategies to reduce wall thinning due to FAC.

The applicant also stated that, after industry experience indicated that feedwater heaters may be subject to flow-accelerated corrosion, VCSNS conducted an inspection of feedwater heaters that revealed some degradation of the pressure boundary. The repair of the subject feedwater heater was accomplished in accordance with the requirements of the applicable code. Some degradation of the feedwater piping was also found downstream of the feedwater regulating valves and has subsequently replaced. The applicant reviewed the refueling summary reports for each refueling outage since RF-8 in 1994 and concluded that the FAC Monitoring Program at VCSNS is a mature, reliable FAC monitoring program.

By letter dated September 12, 2002, SCE&G supplemented the license renewal application for VCSNS. The letter provided the results of the additional reviews based on the NRC staff positions on scoping of seismic II/I piping systems in letters dated December 3, 2001, and

March 15, 2002. As a result, VCSNS added several additional SSCs into the scope of license renewal, and expanded the scope of several aging management programs including the FAC Monitoring Program. The staff's evaluation is provided below.

Staff Evaluation

In LRA Section B.1.6, the applicant describes FAC Program as an existing aging management program that is consistent with GALL AMP XI.M17, "Flow-Accelerated Corrosion." The applicant's claim of consistency with the GALL report was reviewed and verified during an AMR audit conducted on July 16 - 17, 2003. Based on the consistency of this program with the GALL report, the staff focused its review on the operating history program element supporting the effectiveness of this program.

[Operating Experience] The applicant stated that the need for inspections is determined by a calculation performed in accordance with engineering procedures. In addition, components exhibiting extensive degradation during a cycle are replaced with more FAC-resistant materials. As described in GALL AMP XI.M17, the EPRI document, NSAC-202L-R2, "Recommendations for an Effective Flow-Accelerated Corrosion Program," recommends the use of a predictive method for determining the rate at which component degradation is occurring due to FAC. The NRC staff notes that CHECWORKS™ or a similar predictive code should be used to predict component degradation in the systems susceptible to FAC. The systems susceptible to FAC are indicated by specific plant data, including material, hydrodynamic, and operating conditions. By letter dated March 28, 2003, the staff requested, in RAI B.1.6-1, the applicant to discuss the "calculation performed in accordance with engineering procedures" used to determine inspection locations and frequency. Specifically, the staff requested information about the methods used at VCSNS for predicting component degradation by FAC and how these predictive methods are used to determine the need and frequency of inspections.

In its response dated June 12, 2003, the applicant stated that the Flow-Accelerated Corrosion Monitoring Program is consistent with the basic guidelines and recommendations contained in EPRI NSAC-202L-R2. The applicant further stated that inspection frequency varies for each location depending on the trending of inspection results, analytical model review, changes in operating or chemistry conditions, pertinent industry operating experience, plant operating experience, and engineering judgment. The most probable locations of significant wall thinning are given the highest priority with respect to scheduling inspections during each outage; this provides sufficient lead time should any corrective action be deemed necessary.

The staff finds that the applicant appropriately applied a predictive code, such as CHECWORKS™, that uses the implementation guidance of NSAC-202L-R2 to satisfy the criteria specified in 10 CFR Part 50, Appendix B, for development of procedures and control of special processes. Based on the use of the predictive code and its results in the planned inspections, the staff finds that the applicant's response demonstrates effective use of predictive and confirmatory methods; therefore, RAI B.1.6-1 is considered closed.

An effective FAC program, as described in GALL AMP XI.M17, consists of (1) an analysis to determine critical locations, (2) limited baseline inspections to determine the extent of thinning at these locations, and (3) follow-up inspections to confirm the predictions, or repairing or replacing components as necessary. By letter dated March 28, 2003, the staff requested, in RAIs B.1.6-2 and B.1.6-3, the applicant to list those systems, within the program's scope, most

susceptible to FAC. The staff also requested a sample list of components susceptible to FAC with each component's initial, current, and future predicted wall thicknesses, to demonstrate the effectiveness of the Flow-Accelerated Corrosion Monitoring Program. In its response dated June 12, 2003, the applicant stated that the Flow-Accelerated Corrosion Monitoring Program will detect loss of material due to FAC prior to the loss of component intended function. The applicant referenced the October 1992 NRC Inspection Report 50-395/92-20, which stated, "The licensee has established an effective program to maintain high energy carbon steel piping systems within acceptable wall thickness limits." The staff finds that while the referenced inspection report affords some assurance of the effectiveness of the Flow-Accelerated Corrosion Monitoring Program, the report did not supply the information sought by the staff. Therefore, the staff requested a list of those systems, within the program scope, and the components most susceptible to FAC, in addition to the initial, current, and future predicted wall thicknesses, to demonstrate the effectiveness of the Flow-Accelerated Corrosion Monitoring Program.

In subsequent correspondence dated September 2, 2003, the applicant discussed the integration of prediction and inspection inherent in its FAC program. The applicant stated the system most susceptible to FAC at VCSNS is the extraction steam system. This conclusion has been confirmed by the applicant's predictive model and the as-found ultrasonic data for many components. The predictive model of record (CHECWORKS™) represents an analysis tool used by the applicant in the selection of problem areas. This model also aids in the inspection scheduling process. Over time, the applicant determined that model predictions with as-found ultrasonic data have returned reasonable agreement. The applicant provided an example of the predicted vs. measured wear comparisons for components in the extraction steam system summarized below.

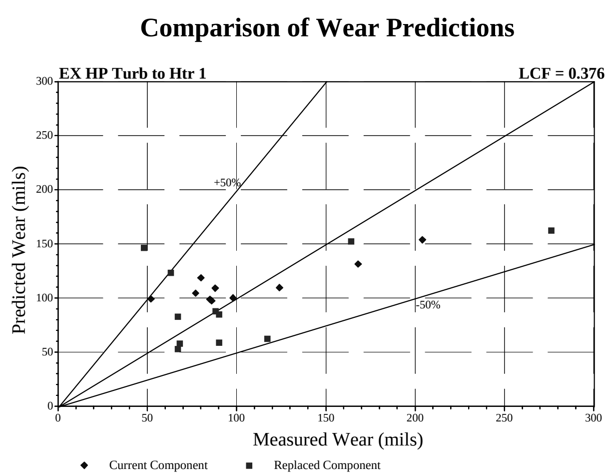

Figure 1: Wear Degradation of Components in the Extraction Steam System: Theory vs. Actual
Data shown above reflects as-found data populated since power up-rate in 1996.

The applicant stated that based on the predictive model, deviations on wear plots should be within ± 50 percent. The above plot shows a fairly well-calibrated extraction steam analysis line. The line correction factor (LCF) of 0.376 indicates that the model is slightly, yet conservatively, over-predicting wear. As can be seen from the plot above, the applicant observed generally good agreement between predicted and measured wear. The applicant

also stated that “programmatic elements that are designed to complement the predictive model, and guard against unexpected problems include: 1) a graded approach to wear classification, 2) a sample expansion set point thickness, and 3) a mandatory calculated remaining service life, wear rate, and projected thickness for each inspected component, separate from the predictive model.”

The applicant provided an example of the most susceptible components. The heater vent piping components were identified and coded as being “equipment out of norm” in the Corrective Action Program during RF-13 in 2002, and slated for future followup. This identification occurred through the procedure of grading current as-found measured wear as insignificant, significant, excessive, and failure. The wear classification entry point for initiating a Condition Evaluation Report is set at the excessive level.

The applicant created a "set point” thickness to serve as a threshold or "trigger” value to perform expanded sample inspections. The threshold value represents thinning beyond the significant classification into the excessive classification; however, it signals the halfway point margin to protect the code allowable thickness value.

The applicant stated that the inspection data for each component will be evaluated to determine wear, wear rate, projected thickness at next refueling outage, service life and re-inspection interval, wear classification, and sample expansion requirements. The applicant indicated that the evaluation of the above items is necessary in determining planned re-inspection intervals, planned replacements, and predictive model calibration input.

The applicant has presented a combination of reasonable agreement between the predicted thickness and the as-found thickness as determined by ultrasonic data. In addition, the procedure’s classification system for the as-found condition includes preventive measures to replace a component prior to compromising the component’s design thickness. The staff finds that the applicant has satisfactorily demonstrated the effectiveness of the Flow-Accelerated Corrosion Monitoring Program in predicting the wall thicknesses of susceptible components by verifying the FAC code predictions with the measured thicknesses, and by having procedures to ensure appropriate management. Therefore, the staff finds the applicant’s response adequate and RAI B.1.6-2 and B.1.6-3 are considered closed.

The staff reviewed the criteria 2 supplemental information in Section B.1.6, “Flow-Accelerated Corrosion Monitoring Program,” in which the applicant stated that this program is applicable to systems, or portions of system, that meet the susceptibility criteria and is not dependent on a safety classification. The applicant concluded that this AMP is also applicable to components which meet the 10 CFR 54.4(a)(2) criteria and are susceptible to flow-accelerated corrosion (FAC). In addition, the applicant concluded that this AMP provides reasonable assurance that FAC will be managed such that spatial interactions will not result in adverse impact to the performance of safety-related functions consistent with the CLB during the period of extended operation.

The staff concurs with the applicant’s conclusions because this AMP includes analysis to determine critical locations for FAC occurrence independent of its safety classification, inspections to determine the extent of thinning at these locations, and additional inspections to confirm the predictions, or repairing or replacing components as necessary.

Section 18.2.17 of Appendix A to the LRA provided the applicant FSAR supplement for the Flow-Accelerated Corrosion Monitoring Program at VCSNS. The staff reviewed the FSAR supplement and finds the summary description of the Flow-Accelerated Corrosion Monitoring Program consistent with Section B.1.6 of the LRA. The staff finds that the information contained in the FSAR supplement presents an adequate summary of the program activities as required by 10 CFR 54.21(d).

Conclusions

On the basis of its review and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.4.2.3.2 Preventive Maintenance Activities — Terry Turbine Program

Summary of Technical Information in the Application

The applicant's Preventive Maintenance Activities — Terry Turbine Program is discussed in LRA Section B.1.25, "Preventive Maintenance Activities—Terry Turbine." This AMP is not consistent with a GALL AMP. The LRA credits this preventive maintenance program with managing aging in the turbine casing and components at the VCSNS exposed to an air environment, with periodic exposures to steam. The preventive maintenance detects and assesses the condition of carbon steel components affected by aging, which may cause loss of material due to general corrosion. In Section B.1.25 of the LRA, the applicant described its preventive maintenance for the Terry Turbine as an existing AMP that manages loss of material due to general corrosion of carbon steel exposed to ambient, moist air and periodic exposure to steam.

The applicant stated that the Preventive Maintenance Activities — Terry Turbine AMP is a condition monitoring program composed of controlled plant procedures. In the LRA, this AMP is applied only to the main steam system in the steam and power conversion systems. The components monitored (LRA Table 3.4-2, Item 4) include the emergency feedwater pump turbine (casing only), valve (body only) and the emergency feedwater pump turbine governor valve. The applicant stated that the purpose of the Preventive Maintenance Activities—Terry Turbine AMP is to manage loss of material in carbon steel due to general corrosion of the turbine casing and associated components. These components are normally exposed to ambient conditions with periodic exposure to steam, allowing moisture to accumulate. Routine maintenance and inspections are conducted, which include detection of age-related degradation and initiation of corrective actions as necessary (LRA Appendix A, Section 18.2.41).

In Section B.1.25 of the LRA, the applicant indicated that the Preventive Maintenance Activities—Terry Turbine Program has been demonstrated to be capable of detecting and managing loss of material in carbon steel components of the Terry Turbine. The Preventive

Maintenance Activities—Terry Turbine Program provides reasonable assurance that the aging effects will be managed such that the components subject to AMR will continue to perform their intended functions consistent with the CLB for the period of extended operation.

Staff Evaluation

In LRA Section B.1.25, "Preventive Maintenance Activities — Terry Turbine Program," the applicant described its AMP to manage aging in the turbine csing and components at the VCSNS exposed to an air environment, with periodic exposures to steam. The staff reviewed the program using the guidance in BTP RLSB-1 in Appendix A of the SRP-LR. The staff's evaluation focused on the management of aging effects through incorporation of the following 10 elements from BTP RLSB-1—program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience. The applicant indicated that the corrective actions, confirmation process, and administrative controls for license renewal are in accordance with the site-controlled Quality Assurance Program. The staff's evaluation of the applicant's Quality Assurance Program is provided separately in Section 3.0.4 of this SER; the evaluation of the remaining seven elements is provided below. The staff also reviewed the FSAR supplement to determine whether it provides an adequate description of the program.

[Program Scope] The applicant stated that this AMP is applicable to the turbine casing and components exposed to an air environment, with periodic exposure to steam. The staff finds that the systems and components monitored by the Preventive Maintenance Activities—Terry Turbine Program, as listed in Section B.1.25 of the LRA, are within the scope of license renewal, as identified in Section 2.3 of the LRA. The scope is acceptable to the staff because it includes those components that rely on the program for aging management.

[Preventive Actions] The applicant stated that no actions are taken as part of the Preventive Maintenance Activities—Terry Turbine Program to prevent the aging effect (loss of material) or to mitigate aging degradation. The staff did not identify the need for preventive actions in this AMP.

[Parameters Monitored or Inspected] The Preventive Maintenance Activities—Terry Turbine Program inspects the turbine casing and exposed components for visible evidence of corrosion on internal surfaces that indicating potential loss of material. The staff finds the above parameters acceptable because they are directly related to the degradation of carbon steel components. In addition, visual inspections are effective in detecting such conditions.

[Detection of Aging Effects] The applicant stated that the managed aging effect (loss of material) is identified by visual inspection prior to a loss of component intended function. The applicant stated that the presence and extent of the aging effect on internal surfaces will be detected. This aging effect is loss of material due to general corrosion. The staff finds that these inspection techniques are sufficient to provide reasonable assurance that the aging effect for the components addressed by the Preventive Maintenance Activities—Terry Turbine Program will be detected before the loss of intended function.

[Monitoring and Trending] The applicant stated that "routine periodic visual inspections are conducted in order to detect age-related degradation and to initiate corrective actions as

necessary." By letter dated March 28, 2003, the staff requested, in RAI B.1.25-1, the applicant to specify the frequency of these periodic inspections or how the inspection frequency is determined. In its response dated June 12, 2003, the applicant stated that the Preventive Maintenance Activities—Terry Turbine Program is the license renewal name for the preventive maintenance activity already being routinely performed on the component that can be credited for managing aging during the period of extended operation. The applicant further stated that the activity that inspects the Terry Turbine (turbine-driven emergency feedwater pump) is performed every third refueling outage (4.5 years). The staff subsequently learned that the VCSNS Engineering Services Technical Report TROO160-020 Program/Activity Evaluation for License Renewal (Revision 0; October 2002) supplied further background on how routine the periodic examinations actually were. The document states on page 2 of 3 in Attachment XXV that the turbine inspection is performed using procedure MMP-300.015 on a 3 RF schedule (4.5 years). The inspection was last performed in October of 1997 (RF-10). The next inspection was scheduled for May of 2002 (RF-13), but was delayed until October of 2003 (RF-14). The staff is concerned that exceeding the identified inspection interval may not be acceptable in detecting aging effects prior to loss of component function. During a telecommunication on July 14, 2003, the applicant identified that the inspection interval was based on vendor recommendations. By letter dated September 2, 2003, the applicant confirmed that the inspection interval is based on a vendor recommended interval of 5 years, but EPRI/NMAC guide, TR-105874, recommends an interval of three or four refueling cycles, a typical time of 6 to 8 years. The staff finds that the applicant's response satisfactorily addresses the staff's concerns and RAI B.1.25-1 is considered closed.

[Acceptance Criteria] The applicant stated that the acceptance criterion is "no unacceptable visible indication of loss of material." The applicant further verifies that indications of loss of material are evaluated by engineering to determine if the condition could result in a loss of the component intended function(s). The staff finds that this acceptance criterion is adequate to ensure that the component intended function(s) are maintained under all CLB design conditions during the period of extended operation.

[Operating Experience] The applicant stated that a review of work histories for the past 10 years revealed that no age-related degradation had been detected for the subject components. The staff finds that the applicant's operating experience indicates that this AMP has effectively maintained the integrity of the components, and the effects of aging will be adequately managed during the period of extended operation.

In summary, based on this review, the staff concludes that the Preventive Maintenance Activities—Terry Turbine AMP is consistent with the requirements of the 10 elements of the BTP RLSB-1 in Appendix A of the SRP-LR. The staff verified that the components, as identified in Section 2 of the LRA, to which the Preventive Maintenance Activities—Terry Turbine Program applies, are commensurate with the intent of the GALL Program.

Section 18.2.41 of Appendix A to the LRA contains the applicant's FSAR supplement for the Preventive Maintenance Activities—Terry Turbine Program at VCSNS. The staff reviewed the FSAR supplement and found that the description of the Preventive Maintenance Activities—Terry Turbine Program is consistent with Section B.1.25 of the LRA. The staff finds that, pending clarifications as a result of issues identified in the AMR inspection, the information contained in the FSAR supplement presents an adequate summary of the program activities, as required by 10 CFR 54.21(d).

Conclusions

On the basis of its review of the applicant's program, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.4.2.4 Aging Management Review of Plant-Specific Steam and Power Conversion Systems Components

The following sections provide the results of the staff's evaluation of the adequacy of aging management for SPC systems components.

3.4.2.4.1 Auxiliary Boiler Steam and Feedwater System

Summary of Technical Information in the Application

The AMR results for the auxiliary boiler steam and feedwater system are presented in Tables 3.4-1 and 3.4-2 of the LRA. The applicant used the GALL Report format to present its AMR of auxiliary boiler steam and feedwater system components in LRA Table 3.4-1. In LRA Table 3.4-2, the applicant identified the component group designation along with its (1) material, (2) environment, (3) aging effects, and (4) AMPs.

As described in Section 2.3.4.1, the auxiliary boiler steam and feedwater system provides steam to various plant equipment as required during all modes of plant operation. This system is nonnuclear safety-related. The mechanical license renewal function of this system is to isolate the section of AS piping supplying the auxiliary building in order to prevent a high energy fluid piping rupture from affecting nuclear safety-related equipment in the auxiliary building.

Aging Effects:

LRA Tables 3.4-1and 3.4-2 identify the following applicable aging effects for the auxiliary boiler steam and feedwater system:

- loss of material due to general corrosion of carbon and low-alloy steel components (external surfaces) in air, moisture, and humidity environments

- loss of material due to pitting and crevice corrosion of carbon steel components in a steam environment

- loss of material due to boric acid corrosion of carbon steel components (external surfaces) in air, leaking, and dripping chemically treated borated water environments

- crevice corrosion, pitting corrosion, and stress-corrosion cracking of stainless steel components in a treated water environment

- loss of material due to general, pitting, and crevice corrosion and MIC of carbon steel components in soil and ground water environments

Aging Management Programs:

The following AMPs are utilized to manage aging effects to the auxiliary boiler steam and feedwater system:

- Chemistry Program
- Inspections for Mechanical Components Program
- Maintenance Rule Structures Program
- Boric Acid Corrosion Surveillances Program
- Buried Pipe and Tanks Inspection Program

A description of these AMPs is provided in Appendix B of the LRA. The applicant indicated that the effects of aging associated with the components of the auxiliary boiler steam and feedwater system will be adequately managed by these AMPs such that there is reasonable assurance that the intended functions will be maintained consistent with the CLB during the period of extended operation.

Staff Evaluation

In addition to Section 3.4 of the LRA, the staff reviewed the pertinent information provided in Section 2.3.4, "Steam and Power Conversion Systems," and the applicable AMP descriptions provided in Appendix B of the LRA to determine whether the aging effects for the auxiliary boiler steam and feedwater system components have been properly identified and will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

This section of the SER provides the staff's evaluation of the applicant's AMR for the aging effects and the appropriateness of the programs credited for the aging management of the auxiliary boiler steam and feedwater system components at VCSNS. The staff's evaluation includes a review of the aging effects considered and the basis for the applicant's elimination of certain aging effects. In addition, the staff has evaluated the appropriateness of the AMPs that are credited for managing the identified aging effects for the auxiliary boiler steam and feedwater system components.

Aging Effects:

The component groups identified in LRA Table 2.3.38 for the auxiliary boiler steam and feedwater system are pipe and valves. The staff reviewed the aging effects identified in LRA Tables 3.4-1 and 3.4-2 for these component groups and finds the applicant properly identified the aging effects for these component groups. The aging effects are listed in SER Section 3.4.2.4.1.

The aging effects identified in the LRA for the auxiliary boiler steam and feedwater system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs:

The following AMPs are utilized to manage aging effects to the auxiliary boiler steam and feedwater system.

- Chemistry Program
- Inspections for Mechanical Components Program
- Maintenance Rule Structures Program
- Boric Acid Corrosion Surveillances Program
- Buried Pipe and Tanks Inspection Program

Each of the above AMPs is credited with managing the aging of several components in different structures and systems and are, therefore, considered common AMPs. The staff review of the common AMPs is in Section 3.0.3 of this SER.

In Table 3.4-1, Item 12 of the LRA, the applicant stated that there is underground piping in the auxiliary feedwater system. The Buried Pipe and Tanks Inspection Program will manage the aging effects for this underground piping. Table 2.3-40 of the LRA, for the emergency feedwater system, only identifies orifices as subject to aging management by the Buried Pipe and Tanks Inspection Program. The staff issued RAI 3.4-14, requesting the applicant to explain why the auxiliary feedwater system piping in Table 2.3-40 does not refer to the Buried Pipe and Tanks Inspection Program and how the underground piping in the auxiliary feedwater system is managed for aging.

In its response by letter dated June 12, 2003, the applicant stated that Table 2.3-40 of the LRA should have included reference to Table 3.4-1, Item 12 in the AMR results for pipe. Table 3.4-1, Item 12, states that the Buried Pipe and Tanks Inspection Program is the credited program to manage aging for underground piping in the emergency feedwater system.

The staff finds the applicant’s response to RAI 3.4-14, reasonable and acceptable because it provides an explanation that the underground auxiliary feedwater system piping is managed against aging effects by the Buried Pipe and Tanks Inspection Program.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the auxiliary boiler steam and feedwater system components will effectively manage or monitor the aging effects identified in the LRA.

<u>Conclusions</u>

On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.4.2 Condensate System

<u>Summary of Technical Information in the Application</u>

The AMR results for the condensate system are presented in Tables 3.4-1 and 3.4-2 of the LRA. The applicant used the GALL Report format to present its AMR of condensate system components in LRA Table 3.4-1. In LRA Table 3.4-2, the applicant identified the component group designation along with its (1) material, (2) environment, (3) aging effects, and (4) AMPs.

As described in Section 2.3.4.2, the condensate system is designed to pump exhaust steam from the main condenser hotwell through the low pressure feedwater heaters to maintain deaerator storage tank level for anticipated operating conditions. It also serves as a source of cooling water for the steam packing condenser and steam generator blowdown heat exchanger, and provides sealing water for various vacuum valves and feedwater pump seals.

Except for the CST, the condensate system is nonnuclear, safety-related. The CST is safety-related since it is the primary inventory source for the emergency feedwater system. Makeup water to the CST is demineralized water, admitted through the condenser and condenser storage subsystem.

Aging Effects:

LRA Tables 3.4-1 and 3.4-2 identify the following applicable aging effects for the condensate system:

- loss of material due to general (carbon steel only), pitting, and crevice corrosion of carbon and stainless steel components in treated water and steam environments

- loss of material due to general (carbon steel only), pitting, and crevice corrosion in sun, weather, humidity, and moisture environments

Aging Management Programs:

The following AMPs are utilized to manage aging effects to the condensate system:

- Chemistry Program
- Inspections for Mechanical Components Program
- Maintenance Rule Structures Program

A description of these AMPs is provided in Appendix B of the LRA. The applicant indicated that the effects of aging associated with the components of the condensate system will be adequately managed by these AMPs such that there is reasonable assurance that the intended functions will be maintained consistent with the CLB during the period of extended operation.

Staff Evaluation

In addition to Section 3.4 of the LRA, the staff reviewed the pertinent information provided in Section 2.3.4, "Steam and Power Conversion Systems," and the applicable AMP descriptions provided in Appendix B of the LRA to determine whether the aging effects for the condensate system components have been properly identified and will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

This section of the SER provides the staff's evaluation of the applicant's AMR for the aging effects and the appropriateness of the programs credited for the aging management of the condensate system components at VCSNS. The staff's evaluation includes a review of the aging effects considered and the basis for the applicant's elimination of certain aging effects. In addition, the staff has evaluated the appropriateness of the AMPs that are credited for managing the identified aging effects for the condensate system components.

Aging Effects:

The component group identified in LRA Table 2.3.26 for the condensate system is the condensate storage tank.

In Table 3.4-1, Item 11 of the LRA, the applicant stated that the Inspections of Mechanical Components Program is used to monitor the external surfaces of the aboveground CST for loss of material. For tanks supported on earthen or concrete foundations, corrosion may occur at inaccessible locations, such as the tank bottom. The staff issued RAI 3.4-13, requesting the applicant to explain if the bottom of the CST is located on an earthen or concrete foundation, and if so, to provide justification for not managing aging effects on the exterior, bottom portion of the tank.

In its response by letters dated June 12, 2003, and September 2, 2003, the applicant stated that the below grade foundation of the CST is comprised of a 4 foot thick slab of reinforced concrete, the top of which is 1 foot below grade. A reinforced concrete, circular ringwall that is 2 feet high and 2½ feet thick connects to this slab and extends from the top of the slab to 1 foot above grade. The CST attaches to the top of this ringwall by a base ring flange, which is anchored to the ringwall by anchor bolts. All voids between the ringwall and base ring are grouted. The outer edge of the base ring is coated with cold plastic coal tar pitch flashing compound. Inside this ringwall, the CST sits on a clean, dry sand bed (as originally poured), which extends from the top of the foundation slab to the top of the ringwall. There are four small ringwall drains penetrating the ringwall 1 foot below grade. These drains are semicircular in shape with a 3-inch radius and are filled with clean, crushed stone to retain the sand within the ringwall.   Because of the grouting and flashing at the base ring, water intrusion to the tank bottom is not expected to occur at the base ring; however, any water intrusion would seep through the sand to the ringwall drains. The four ringwall drains also allow translation of water to and from the sand contained by the ringwall. In the unlikely event that the ground outside of the ringwall becomes moisture saturated for an extended period of time, the sand inside the ringwall could only saturate to grade level. The 1 foot of sand from grade level to the bottom of the tank would remain dry. Because the external surface of the bottom of the CST remains dry, it should experience no aging effects requiring management. Because of the grouting and flashing at the base ring, water intrusion to the tank bottom is not expected to occur at the base ring; however, if it did occur, any water intrusion would seep through the sand to the ringwall drains, therefore, water would not pool at the bottom external surface of the tank. The four ringwall drains also allow translation of water to and from the sand contained by the ringwall. In the unlikely event that the ground outside of the ringwall becomes moisture saturated for an extended period of time, the sand inside the ringwall could only saturate to grade level. The 1 foot of sand from grade level to the bottom of the tank would remain dry. Because the external surface of the bottom of the CST remains dry, it should experience no aging effects requiring management; however, should the tank bottom experience any moisture it is unlikely that the tank would experience any significant degradation. Carbon steel exposed to the ambient, moist

air environment is not expected to experience significant corrosion rates. The ASM Handbook, Volume 13, Corrosion, page 531, graphically depicts the atmospheric corrosion versus time rate for structural steel in an industrial setting. Structural carbon steel loses approximately 1 mil per year for the first ten years, followed by a rate of approximately 0.3 mils per year for the next 50 years. For a sixty-year plant life, this yields a total material loss of approximately 25 mils (10 mils for the first ten years plus 15 mils for the remaining fifty years). The slowing of the corrosion rate is due to the metal producing a protective oxide layer, which protects the surface. Because the ambient environment at VCSNS does not contain contaminants of sufficient quantity to concentrate on external surfaces and because the tanks are grouted to their foundations, it is reasonable to assume that tank bottoms will not experience wall thickness losses beyond 25 mils during the 60-year plant life.

As a verification of the applicant's response that the CST bottom would remain dry and should experience no aging effects requiring management, the staff performed an AMR inspection of the CST. The results of the staff's inspection can be found in Inspection Report 50-395/03-08, dated September 29, 2003. A summary of the inspection results is presented below:

> The team noted that there were no inspections planned for monitoring loss of material due to potential galvanic or general corrosion of the bottom of the Condensate Storage Tank (CST) although this tank was located outdoors. The tank is exposed to rain and water accumulation and appeared to be in contact with the ground. The team verified the applicant's response to RAI 3.4-13 which stated that the design of the CST foundation prevented the establishment of a galvanic cell with the ground and induced drainage to prevent water accumulation at the tank bottom. The CST as-built foundation drawings indicate that the tank is mounted on a four foot thick concrete pad and with a two foot high concrete ringwall. The space between the pad and the tank bottom contains clean sand and drainage pipes have been installed to prevent accumulation of water under the tank. The tank bottom, at the 436 foot elevation, was eleven feet above the ground water elevation of 425 feet. Loss of material of the tank bottom would be at the same rate as the tank sides, which are exposed to a moist air ambient environment, and such a rate would not be a concern for the period of extended operation. The tank exterior is within the scope of the Mechanical Components Inspection Program.

Based on the AMR inspection results, the staff finds the applicant's response to RAI 3.4-13, reasonable and acceptable because it provides an explanation that the CST bottom is not in direct contact with earthen or concrete structures, and by design, the bottom will remain dry and is not susceptible to establishment of a galvanic cell.

The aging effects identified in the LRA for the condensate system components are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs:

The following AMPs are utilized to manage aging effects to the condensate system:

- Chemistry Program
- Inspections for Mechanical Components Program
- Maintenance Rule Structures Program

Each of the above AMPs is credited with managing the aging of several components in different structures and systems and are, therefore, considered common AMPs. The staff review of the common AMPs is presented in Section 3.0.3 of this SER.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the condensate system components will effectively manage or monitor the aging effects identified in the LRA.

Conclusions

On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.4.3 Emergency Feedwater System

Summary of Technical Information in the Application

The AMR results for the emergency feedwater system are presented in Tables 3.4-1 and 3.4-2 of the LRA. The applicant used the GALL Report format to present its AMR of emergency feedwater system components in LRA Table 3.4-1. In LRA Table 3.4-2, the applicant identified the component group designation along with its (1) material, (2) environment, (3) aging effects, and (4) AMPs.

As described in Section 2.3.4.3, the emergency feedwater system is designed to deliver sufficient feedwater to the steam generators for cool down subsequent to a loss of normal feedwater supply (i.e., when the main feedwater system is not available) and during an anticipated transient without scram (ATWS) event. The emergency feedwater system operates in conjunction with the main steam dump system, if available, or the main power relief valves and safety valves, to remove thermal energy from the steam generators. The emergency feedwater system is also used to supply feedwater to the steam generators during testing, startup, shutdown, and layup operations. During normal plant operation, the system is in a standby condition, with the system controls set for automatic operation.

Aging Effects:

LRA Tables 3.4-1 and 3.4-2 identify the following applicable aging effects for the emergency feedwater system:

- loss of material due to general (carbon steel only), pitting, and crevice corrosion of carbon and stainless steel components in treated water and steam environments

- loss of material due to general (carbon steel only), pitting, and crevice corrosion, MIC, and biofouling of carbon steel components in a raw water environment

- loss of material due to general corrosion of carbon and low-alloy steel components (external surfaces) in air, moisture, and humidity environments

- loss of material due to general (carbon steel only), pitting, and crevice corrosion in sun, weather, humidity, and moisture environments

- loss of material due to general, pitting, and crevice corrosion and MIC of carbon steel components in soil and ground water environments

- loss of material due to boric acid corrosion of carbon steel components (external surfaces) in air, leaking, and dripping chemically treated borated water environments

- boric acid corrosion and aggressive chemical attack of aluminum and brass components in an ambient, moist air environment

- crevice corrosion, galvanic corrosion, pitting corrosion, selective leaching, and stress-corrosion cracking of brass components in a treated water environment

Aging Management Programs:

The following AMPs are utilized to manage aging effects to the emergency feedwater system:

- Chemistry Program
- Inspections for Mechanical Components Program
- Maintenance Rule Structures Program
- Buried Pipe and Tanks Inspection Program
- Boric Acid Corrosion Surveillances Program
- Service Water System Reliability and In-Service Testing Program

A description of these AMPs is provided in Appendix B of the LRA. The applicant indicated that the effects of aging associated with the components of the emergency feedwater system will be adequately managed by these AMPs such that there is reasonable assurance that the intended functions will be maintained consistent with the CLB during the period of extended operation.

Staff Evaluation

In addition to Section 3.4 of the LRA, the staff reviewed the pertinent information provided in Section 2.3.4, "Steam and Power Conversion Systems," and the applicable AMP descriptions provided in Appendix B of the LRA to determine whether the aging effects for the emergency feedwater system components have been properly identified and will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

This section of the SER provides the staff's evaluation of the applicant's AMR for the aging effects and the appropriateness of the programs credited for the aging management of the emergency feedwater system components at VCSNS. The staff's evaluation includes a review of the aging effects considered and the basis for the applicant's elimination of certain aging effects. In addition, the staff has evaluated the appropriateness of the AMPs that are credited for managing the identified aging effects for the emergency feedwater system components.

Aging Effects:

The component groups identified in LRA Table 2.3.40 for the emergency feedwater system are (1) filter, (2) heat exchanger shell, (3) heat exchanger tubes, (4) orifices, (5) pipe, (6) pump (casing only), (7) strainers, (8) tank (reservoir), (9) thermowells and piping, (10) tube and tube fittings, and (11) valves. The staff reviewed the aging effects identified in LRA Tables 3.4-1 and 3.4-2 for these component groups and finds the applicant properly identified the aging effects for these component groups. The aging effects are listed in SER Section 3.4.2.4.2.

The aging effects identified in the LRA for the emergency feedwater system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs:

The following AMPs are utilized to manage aging effects to the emergency feedwater system:

- Chemistry Program
- Inspections for Mechanical Components Program
- Maintenance Rule Structures Program
- Buried Pipe and Tanks Inspection Program
- Boric Acid Corrosion Surveillances Program
- Service Water System Reliability and In-Service Testing Program

Each of the above AMPs is credited with managing the aging of several components in different structures and systems and are, therefore, considered common AMPs. The staff review of the common AMPs is presented in Sections 3.0.3 and 3.3.2.3.1 of this SER.

The GALL Report recommends that heat exchanger internals exposed to raw or treated water be managed for loss of material by the Open-Cycle and Closed-Cycle Cooling Water System AMPs. In Table 3.4-1, Items 9 and 10 of the LRA, the LRA states that the Open-Cycle and Closed-Cycle Cooling Water System AMPs, as described in NUREG-1801, are not used in any steam and power conversion systems at VCSNS. The staff issued RAI 3.4-12, requesting the applicant to explain if there any steam and power conversion systems heat exchangers at VCSNS exposed to raw or treated water that require AMR. If so, the applicant was requested to identify the heat exchangers, the aging effects, and how the aging effects are managed.

In its response by letter dated June 12, 2003, the applicant stated that the turbine driven emergency feedwater pump oil cooler is the only SPC systems heat exchanger in scope for license renewal. The internal surfaces of the brass tubes are exposed to the treated water environment of the emergency feedwater system, which is the cooling medium. The possible aging mechanisms for this material-environment combination are crevice corrosion, galvanic corrosion, pitting corrosion, selective leaching, and SCC. In Table 3.4-2, Item 6 of the LRA, the applicant credited the Chemistry Program and the Heat Exchanger Inspections Program for managing aging of the tubes in the treated water environment.

The staff finds the applicant’s response to RAI 3.4-12, reasonable and acceptable because it provides an explanation that the turbine driven emergency feedwater pump oil cooler is managed for aging in a treated water environment.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the emergency feedwater system components will effectively manage or monitor the aging effects identified in the LRA.

<u>Conclusions</u>

On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.4.4 Extraction Steam System

Summary of Technical Information in the Application

The AMR results for the extraction steam system are presented in Tables 3.4-1 and 3.4-2 of the LRA. The applicant used the GALL Report format to present its AMR of extraction steam system components in LRA Table 3.4-1. In LRA Table 3.4-2, the applicant identified the component group designation along with its (1) material, (2) environment, (3) aging effects, and (4) AMPs.

As described in Section 2.3.4.4, the extraction steam system supplies steam for heating the condensate and feedwater and for maintaining the auxiliary boilers in a hot standby condition. The mechanical license renewal function of this system is to provide a means of main steam isolation (when used in conjunction with components from various other systems) for a steam line break coincident with failure of a main steam isolation valve.

Aging Effects:

LRA Tables 3.4-1 and 3.4-2 identify the following applicable aging effects for the extraction steam system:

- loss of material due to general (carbon steel only), pitting, and crevice corrosion of carbon and stainless steel components in treated water and steam environments

- loss of material due to general corrosion of carbon and low-alloy steel components (external surfaces) in air, moisture, and humidity environments

- wall thinning due to flow-accelerated corrosion of carbon steel components in steam and treated water environments

- loss of material due to boric acid corrosion of carbon steel components (external surfaces) in air, leaking, and dripping chemically treated borated water environments

Aging Management Programs:

The following AMPs are utilized to manage aging effects to the extraction steam system:

- Chemistry Program
- Inspections for Mechanical Components Program
- Maintenance Rule Structures Program
- Flow-Accelerated Corrosion Monitoring Program
- Boric Acid Corrosion Surveillances Program
- Heat Exchanger Inspections Program

A description of these AMPs is provided in Appendix B of the LRA. The applicant indicated that the effects of aging associated with the components of the extraction steam system will be adequately managed by these AMPs such that there is reasonable assurance that the intended functions will be maintained consistent with the CLB during the period of extended operation.

Staff Evaluation

In addition to Section 3.4 of the LRA, the staff reviewed the pertinent information provided in Section 2.3.4, "Steam and Power Conversion Systems," and the applicable AMP descriptions provided in Appendix B of the LRA to determine whether the aging effects for the extraction steam system components have been properly identified and will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

This section of the SER provides the staff's evaluation of the applicant's AMR for the aging effects and the appropriateness of the programs credited for the aging management of the extraction steam system components at VCSNS. The staff's evaluation includes a review of the aging effects considered and the basis for the applicant's elimination of certain aging effects. In addition, the staff has evaluated the appropriateness of the AMPs that are credited for managing the identified aging effects for the extraction steam system components.

Aging Effects:

The component groups identified in LRA Table 2.3.41 for the extraction steam system are piping and valve bodies. The staff reviewed the aging effects identified in LRA Tables 3.4-1 and 3.4-2 for these component groups and finds the applicant properly identified the aging effects for these component groups. The aging effects are listed in SER Section 3.4.2.4.4.

The aging effects identified in the LRA for the extraction steam system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs:

The following AMPs are utilized to manage aging effects to the extraction steam system:

- Chemistry Program
- Inspections for Mechanical Components Program
- Maintenance Rule Structures Program
- Flow-Accelerated Corrosion Monitoring Program
- Boric Acid Corrosion Surveillances Program
- Heat Exchanger Inspections Program

Each of the above AMPs (except the Flow-Accelerated Corrosion Monitoring AMP) is credited with managing the aging of several components in different structures and systems and are, therefore, considered common AMPs. The staff review of the common AMPs is presented in Section 3.0.3 of this SER. The Flow-Accelerated Corrosion Monitoring Program is credited with managing aging effects in the SPC systems only and is, therefore, considered a plant-specific

AMP. Staff review of the Flow-Accelerated Corrosion Monitoring Program is described in Section 3.4.2.3.1 of this SER.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the extraction steam system components will effectively manage or monitor the aging effects identified in the LRA.

Conclusions

On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.4.5 Feedwater System

Summary of Technical Information in the Application

The AMR results for the feedwater system are presented in Tables 3.4-1 and 3.4-2 of the LRA. The applicant used the GALL Report format to present its AMR of feedwater system components in LRA Table 3.4-1. In LRA Table 3.4-2, the applicant identified the component group designation along with its (1) material, (2) environment, (3) aging effects, and (4) AMPs.

As described in Section 2.3.4.5, the feedwater system is designed to pump feedwater from the deaerator storage tank through two stages of high pressure heaters to the steam generators. The operation of this system ensures that the required amount of heated and deaerated water is available to maintain an adequate steam generator water level during normal plant operation and transients. The nuclear portion of the feedwater system conveys feedwater from the non-nuclear portion of the feedwater system (located within the turbine building) to the steam generators and includes the containment isolation valves.

Aging Effects:

LRA Tables 3.4-1 and 3.4-2 identify the following applicable aging effects for the feedwater system:

- loss of material due to general (carbon steel only), pitting, and crevice corrosion of carbon and stainless steel components in treated water and steam environments

- loss of material due to general corrosion of carbon and low-alloy steel components (external surfaces) in air, moisture, and humidity environments

- wall thinning due to flow-accelerated corrosion of carbon steel components in steam and treated water environments

- loss of material due to boric acid corrosion of carbon steel components (external surfaces) in air, leaking, and dripping chemically treated borated water environments

Aging Management Programs:

The following AMPs are utilized to manage aging effects to the feedwater system:

- Chemistry Program
- Inspections for Mechanical Components Program
- Maintenance Rule Structures Program
- Flow-Accelerated Corrosion Monitoring Program
- Boric Acid Corrosion Surveillances Program

A description of these AMPs is provided in Appendix B of the LRA. The applicant indicated that the effects of aging associated with the components of the feedwater system will be adequately managed by these AMPs such that there is reasonable assurance that the intended functions will be maintained consistent with the CLB during the period of extended operation.

<u>Staff Evaluation</u>

In addition to Section 3.4 of the LRA, the staff reviewed the pertinent information provided in Section 2.3.4, "Steam and Power Conversion Systems," and the applicable AMP descriptions provided in Appendix B of the LRA to determine whether the aging effects for the feedwater system components have been properly identified and will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

This section of the SER provides the staff's evaluation of the applicant's AMR for the aging effects and the appropriateness of the programs credited for the aging management of the feedwater system components at VCSNS. The staff's evaluation includes a review of the aging effects considered and the basis for the applicant's elimination of certain aging effects. In addition, the staff has evaluated the appropriateness of the AMPs that are credited for managing the identified aging effects for the feedwater system components.

Aging Effects:

The component groups identified in LRA Table 2.3.42 for the feedwater system are flow venturi, pipe, tube and tube fittings, and valves. The staff reviewed the aging effects identified in LRA Tables 3.4-1 and 3.4-2 for these component groups and finds the applicant properly identified the aging effects for these component groups. The aging effects are listed in SER Section 3.4.2.4.5.

The aging effects identified in the LRA for the feedwater system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs:

The following AMPs are utilized to manage aging effects to the feedwater system:

- Chemistry Program
- Inspections for Mechanical Components Program
- Maintenance Rule Structures Program
- Flow-Accelerated Corrosion Monitoring Program

- Boric Acid Corrosion Surveillances Program

Each of the above AMPs (except the Flow-Accelerated Corrosion Monitoring AMP) is credited with managing the aging of several components in different structures and systems and are, therefore, considered common AMPs. The staff review of the common AMPs is presented in Section 3.0.3 of this SER. The Flow-Accelerated Corrosion Monitoring Program is credited with managing aging effects in the SPC systems only and is, therefore, considered a plant-specific AMP. Staff review of the Flow-Accelerated Corrosion Monitoring Program is described in Section 3.4.2.3.1 of this SER.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the feedwater system components will effectively manage or monitor the aging effects identified in the LRA.

Conclusions

On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.4.6 Gland Sealing Steam System

Summary of Technical Information in the Application

The AMR results for the gland sealing steam system are presented in Tables 3.4-1 and 3.4-2 of the LRA. The applicant used the GALL Report format to present its AMR of gland sealing steam system components in LRA Table 3.4-1. In LRA Table 3.4-2, the applicant identified the component group designation along with its (1) material, (2) environment, (3) aging effects, and (4) AMPs.

As described in Section 2.3.4.6, the gland sealing steam system is designed to provide steam to the main turbine and feedwater pump turbine shaft seals in order to prevent air leakage into and/or steam leakage out of the turbine casings. Sealing steam is normally supplied to the gland sealing steam system from the main steam system under all load conditions, but may be provided by the auxiliary boiler through the auxiliary steam system. The mechanical license renewal function of this system is to provide a means of main steam isolation (when used in conjunction with components from various other system) for a steam line break coincident with failure of a main steam isolation valve.

Aging Effects:

LRA Tables 3.4-1 and 3.4-2 identify the following applicable aging effects for the gland sealing steam system:

- loss of material due to general corrosion of carbon and low-alloy steel components (external surfaces) in air, moisture, and humidity environments

- wall thinning due to flow-accelerated corrosion of carbon steel components in steam and treated water environments

- loss of material due to pitting and crevice corrosion of carbon steel components in a steam environment

Aging Management Programs:

The following AMPs are utilized to manage aging effects to the gland sealing steam system:

- Chemistry Program
- Inspections for Mechanical Components Program
- Maintenance Rule Structures Program
- Flow-Accelerated Corrosion Monitoring Program

A description of these AMPs is provided in Appendix B of the LRA. The applicant indicated that the effects of aging associated with the components of the gland sealing steam system will be adequately managed by these AMPs such that there is reasonable assurance that the intended functions will be maintained consistent with the CLB during the period of extended operation.

Staff Evaluation

In addition to Section 3.4 of the LRA, the staff reviewed the pertinent information provided in Section 2.3.4, "Steam and Power Conversion Systems," and the applicable AMP descriptions provided in Appendix B of the LRA to determine whether the aging effects for the gland sealing steam system components have been properly identified and will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

This section of the SER provides the staff's evaluation of the applicant's AMR for the aging effects and the appropriateness of the programs credited for the aging management of the gland sealing steam system components at VCSNS. The staff's evaluation includes a review of the aging effects considered and the basis for the applicant's elimination of certain aging effects. In addition, the staff has evaluated the appropriateness of the AMPs that are credited for managing the identified aging effects for the gland sealing steam system components.

Aging Effects:

The component groups identified in LRA Table 2.3.43 for the gland sealing steam system are pipe and valves. The staff reviewed the aging effects identified in LRA Tables 3.4-1 and 3.4-2 for these component groups and finds the applicant properly identified the aging effects for these component groups. The aging effects are listed in SER Section 3.4.2.4.6.

The aging effects identified in the LRA for the gland sealing steam system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs:

The following AMPs are utilized to manage aging effects to the gland sealing steam system:

- Chemistry Program
- Inspections for Mechanical Components Program
- Maintenance Rule Structures Program
- Flow-Accelerated Corrosion Monitoring Program

Each of the above AMPs (except the Flow Accelerated Corrosion AMP) are credited with managing the aging of several components in different structures and systems and are, therefore, considered common AMPs. The staff review of the common AMPs is presented in Section 3.0.3 of this SER. The Flow Accelerated Corrosion AMP is credited with managing aging effects in the SPC systems only and is, therefore considered a plant-specific AMP. Staff review of the Flow Accelerated Corrosion AMP is in Section 3.4.2.3.1 of this SER.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the gland sealing steam system components will effectively manage or monitor the aging effects identified in the LRA.

<u>Conclusions</u>

On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.4.7 Main Steam System

<u>Summary of Technical Information in the Application</u>

The AMR results for the main steam system are presented in Tables 3.4-1 and 3.4-2 of the LRA. The applicant used the GALL Report format to present its AMR of main steam system components in LRA Table 3.4-1. In LRA Table 3.4-2, the applicant identified the component group designation along with its (1) material, (2) environment, (3) aging effects, and (4) AMPs .

As described in Section 2.3.4.7, the main steam system conveys saturated steam from the three steam generators to the turbine-generator. Main steam is also supplied, through branch lines, to the (1) feedwater pump drive turbines, (2) emergency feedwater pump turbines, (3) moisture separator reheaters, (4) auxiliary steam system, (5) deaerating feedwater heater, and (6) steam dumps to the condenser and atmosphere.

Aging Effects:

LRA Tables 3.4-1 and 3.4-2 identify the following applicable aging effects for the main steam system:

- loss of material due to general corrosion of carbon and low-alloy steel components (external surfaces) in air, moisture, and humidity environments

- wall thinning due to flow-accelerated corrosion of carbon steel components in steam and treated water environments

- loss of material due to pitting and crevice corrosion of carbon steel components in a steam environment

- loss of material due to boric acid corrosion of carbon steel components (external surfaces) in air, leaking, and dripping chemically treated borated water environments

- general corrosion of carbon steel components in an ambient, moist air environment

- crevice corrosion, pitting corrosion, and stress-corrosion cracking of stainless steel components in a treated water environment

Aging Management Programs:

The following AMPs are utilized to manage aging effects to the main steam system:

- Chemistry Program
- Inspections for Mechanical Components Program
- Maintenance Rule Structures Program
- Flow-Accelerated Corrosion Monitoring Program
- Boric Acid Corrosion Surveillances Program
- Preventive Maintenance Activities — Terry Turbine Program

A description of these AMPs is provided in Appendix B of the LRA. The applicant indicated that the effects of aging associated with the components of the main steam system will be adequately managed by these AMPs such that there is reasonable assurance that the intended functions will be maintained consistent with the CLB during the period of extended operation.

<u>Staff Evaluation</u>

In addition to Section 3.4 of the LRA, the staff reviewed the pertinent information provided in Section 2.3.4, "Steam and Power Conversion Systems," and the applicable AMP descriptions provided in Appendix B of the LRA to determine whether the aging effects for the main steam system components have been properly identified and will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

This section of the SER provides the staff's evaluation of the applicant's AMR for the aging effects and the appropriateness of the programs credited for the aging management of the main steam system components at VCSNS. The staff's evaluation includes a review of the aging effects considered and the basis for the applicant's elimination of certain aging effects. In addition, the staff has evaluated the appropriateness of the AMPs that are credited for managing the identified aging effects for the main steam system components.

Aging Effects:

The component groups identified in Table 2.3.44 for the main steam system are pump turbine, pipe, valves, and steam traps. The staff reviewed the aging effects identified in LRA Tables 3.4-1 and 3.4-2 for these component groups and finds the applicant properly identified the aging effects for these component groups. The aging effects are listed in SER Section 3.4.2.4.7.

The aging effects identified in the LRA for the main steam system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs:

The following AMPs are utilized to manage aging effects to the main steam system:

- Chemistry Program
- Inspections for Mechanical Components Program
- Maintenance Rule Structures Program
- Flow-Accelerated Corrosion Monitoring Program
- Boric Acid Corrosion Surveillances Program
- Preventive Maintenance Activities—Terry Turbine Program

Each of the above AMPs (except the Flow-Accelerated Corrosion Monitoring and Preventive Maintenance Activities — Terry Turbine AMPs) is credited with managing the aging of several components in different structures and systems and are, therefore, considered common AMPs. The staff review of the common AMPs is presented in Section 3.0.3 of this SER. The Flow-Accelerated Corrosion Monitoring and Preventive Maintenance Activities — Terry Turbine AMPs are credited with managing aging effects in the SPC systems only and are, therefore, considered plant-specific AMPs. The staff review of the Flow-Accelerated Corrosion Monitoring Program is presented in Section 3.4.2.3.1 of this SER and the staff review of the Preventive Maintenance Activities — Terry Turbine Program is discussed in Section 3.4.2.3.2 of this SER.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the main steam system components will effectively manage or monitor the aging effects identified in the LRA.

Conclusions

On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.4.8 Main Steam Dump System

Summary of Technical Information in the Application

The AMR results for the main steam dump system are presented in Tables 3.4-1 and 3.4-2 of the LRA. The applicant used the GALL Report format to present its AMR of main steam dump system components in LRA Table 3.4-1. In LRA Table 3.4-2, the applicant identified the component group designation along with its (1) material, (2) environment, (3) aging effects, and (4) AMPs.

As described in Section 2.3.4.8, the main steam dump system is capable of following a large turbine-generator load reduction without reactor trip through actuation of the main steam dump system. This system bypasses main steam to the main condenser and/or to the atmosphere.

Steam dump valves permit unit operation at turbine loads lower than the minimum power setting (15 percent reactor power) of the nuclear steam supply system (NSSS) automatic control. In addition, the steam dump valves permit reduction of turbine-generator load at a rate greater than the 5 percent per minute maximum rate of load reduction for the NSSS.

The mechanical license renewal function of this system is to provide a means of main steam isolation (when used in conjunction with components from various other systems) for a steam line break coincident with failure of a main steam isolation valve.

Aging Effects:

LRA Tables 3.4-1 and 3.4-2 identify the following applicable aging effects for the main steam dump system:

- loss of material due to general corrosion of carbon and low-alloy steel components (external surfaces) in air, moisture, and humidity environments

- wall thinning due to flow-accelerated corrosion of carbon steel components in steam and treated water environments

- loss of material due to pitting and crevice corrosion of carbon steel components in a steam environment

- loss of material due to boric acid corrosion of carbon steel components (external surfaces) in air, leaking, and dripping chemically treated borated water environments

Aging Management Programs:

The following AMPs are utilized to manage aging effects to the main steam dump system:

- Chemistry Program
- Inspections for Mechanical Components Program
- Maintenance Rule Structures Program
- Flow-Accelerated Corrosion Monitoring Program
- Boric Acid Corrosion Surveillances Program

A description of these AMPs is provided in Appendix B of the LRA. The applicant indicated that the effects of aging associated with the components of the main steam dump system will be adequately managed by these AMPs such that there is reasonable assurance that the intended functions will be maintained consistent with the CLB during the period of extended operation.

<u>Staff Evaluation</u>

In addition to Section 3.4 of the LRA, the staff reviewed the pertinent information provided in Section 2.3.4, "Steam and Power Conversion Systems," and the applicable AMP descriptions provided in Appendix B of the LRA to determine whether the aging effects for the Main steam dump system components have been properly identified and will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

This section of the SER provides the staff's evaluation of the applicant's AMR for the aging effects and the appropriateness of the programs credited for the aging management of the main steam dump system components at VCSNS. The staff's evaluation includes a review of the aging effects considered and the basis for the applicant's elimination of certain aging effects. In addition, the staff has evaluated the appropriateness of the AMPs that are credited for managing the identified aging effects for the main steam dump system components.

Aging Effects:

The component groups identified in LRA Table 2.3.45 for the main steam dump system are pipe, tube and tube fittings, and valves. The staff reviewed the aging effects identified in LRA Tables 3.4-1 and 3.4-2 for these component groups and finds the applicant properly identified the aging effects for these component groups. The aging effects are listed in SER Section 3.4.2.4.8.

The aging effects identified in the LRA for the main steam dump system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs:

The following AMPs are utilized to manage aging effects to the main steam dump system:

- Chemistry Program
- Inspections for Mechanical Components Program
- Maintenance Rule Structures Program
- Flow-Accelerated Corrosion Monitoring Program
- Boric Acid Corrosion Surveillances Program

Each of the above AMPs (except the Flow-Accelerated Corrosion Monitoring AMP) is credited with managing the aging of several components in different structures and systems and are, therefore, considered common AMPs. The staff review of the common AMPs is presented in Section 3.0.3 of this SER. The Flow-Accelerated Corrosion Monitoring Program is credited with managing aging effects in the SPC systems only and is, therefore, considered a plant-specific AMP. Staff review of the Flow-Accelerated Corrosion Monitoring Program is discussed in Section 3.4.2.3.1 of this SER.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the main steam dump system components will effectively manage or monitor the aging effects identified in the LRA.

<u>Conclusions</u>

On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.4.9 Main Turbine and Turbine Accessories Systems

As described in Section 2.3.4.9, the main turbine system receives steam from the steam generators and converts steam energy into mechanical energy for the main generator. The turbine accessories system supplies high pressure bearing lift oil to the turbine and generator bearings to lift the shaft slightly and reduce the torque requirements on the turning gear. These two systems provide a turbine trip signal that has a license renewal function of providing a means of main steam isolation (when used in conjunction with components from various other systems) for a steam line break coincident with failure of a main steam isolation valve.

The applicant's screening review concluded that the main turbine and turbine accessories systems do not perform any intended functions for license renewal; therefore, none of the main turbine and turbine accessories systems components are subject to an AMR.

Staff review of the scoping and screening process in LRA Section 2.3.4.9 concluded that no main turbine and turbine accessories systems components are subject to an AMR.

3.4.2.4.10 Turbine Cycle Sampling System

Summary of Technical Information in the Application

The AMR results for the turbine cycle sampling system are presented in Tables 3.4-1 and 3.4-2 of the LRA. The applicant used the GALL Report format to present its AMR of turbine cycle sampling system components in LRA Table 3.4-1. In LRA Table 3.4-2, the applicant identified the component group designation along with its (1) material, (2) environment, (3) aging effects, and (4) AMPs.

As described in Section 2.3.4.10, the turbine cycle sampling system provides sampling of secondary system fluids from locations such as the main condenser hotwell, deaerator, feedwater booster pumps, high pressure heater drains, emergency feedwater pumps, and main steam system. The mechanical license renewal function of the system is to provide a means of main steam isolation (when used in conjunction with components from various other systems) for a steam line break coincident with failure of a main steam isolation valve.

Aging Effects:

LRA Tables 3.4-1 and 3.4-2 identify the following applicable aging effects for the turbine cycle sampling system:

- loss of material due to general corrosion of carbon and low-alloy steel components (external surfaces) in air, moisture, and humidity environments

- loss of material due to pitting and crevice corrosion of carbon steel components in a steam environment

Aging Management Programs:

The following AMPs are utilized to manage aging effects to the turbine cycle sampling system:

- Chemistry Program
- Inspections for Mechanical Components Program
- Maintenance Rule Structures Program

A description of these AMPs is provided in Appendix B of the LRA. The applicant indicated that the effects of aging associated with the components of the turbine cycle sampling system will be adequately managed by these AMPs such that there is reasonable assurance that the intended functions will be maintained consistent with the CLB during the period of extended operation.

<u>Staff Evaluation</u>

In addition to Section 3.4 of the LRA, the staff reviewed the pertinent information provided in Section 2.3.4, "Steam and Power Conversion Systems," and the applicable AMP descriptions provided in Appendix B of the LRA to determine whether the aging effects for the turbine cycle sampling system components have been properly identified and will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

This section of the SER provides the staff's evaluation of the applicant's AMR for the aging effects and the appropriateness of the programs credited for the aging management of the turbine cycle sampling system components at VCSNS. The staff's evaluation includes a review of the aging effects considered and the basis for the applicant's elimination of certain aging effects. In addition, the staff has evaluated the appropriateness of the AMPs that are credited for managing the identified aging effects for the turbine cycle sampling system components.

Aging Effects:

The component groups identified in LRA Table 2.3.46 for the turbine cycle sampling system are pipe and valves. The staff reviewed the aging effects identified in LRA Tables 3.4-1 and 3.4-2 for these component groups and finds the applicant properly identified the aging effects for these component groups. The aging effects are listed in SER Section 3.4.2.4.10.

The aging effects identified in the LRA for the turbine cycle sampling system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs:

The following AMPs are utilized to manage aging effects to the turbine cycle sampling system:

- Chemistry Program
- Inspections for Mechanical Components Program
- Maintenance Rule Structures Program

Each of the above AMPs is credited with managing the aging of several components in different structures and systems and are, therefore, considered common AMPs. The staff review of the common AMPs is presented in Section 3.0.3 of this SER.

In Section 2.3.4.10 of the LRA, the applicant listed turbine cycle sampling system components subject to AMR. However, Section 3.4.1, which lists VCSNS steam and power conversion systems, does not include the turbine cycle sampling system. The staff issued RAI 3.4-1, requesting the applicant to explain the basis for not including the turbine cycle sampling system in the list of steam and power conversion systems.

In its response by letter dated June 12, 2003, the applicant stated that Section 3.4.1 of the LRA should indeed list the turbine cycle sampling system as a steam and power conversion system. Table 2.3-46 of the LRA for the turbine cycle sampling system refers to Table 3.4-1, Items 5 and 7 of the LRA, which discusses the AMR results for the turbine cycle sampling system components in scope for license renewal.

The staff finds the applicant's response to RAI 3.4-1, reasonable and acceptable because it provides an explanation that aging management of the turbine cycle sampling system is included in the steam and power conversion systems.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the turbine cycle sampling system components will effectively manage or monitor the aging effects identified in the LRA.

Conclusions

On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.4.11 Steam Generator Blowdown System

Summary of Technical Information in the Application

The AMR results for the steam generator blowdown system are presented in Tables 3.4-1 and 3.4-2 of the LRA. The applicant used the GALL Report format to present its AMR of steam generator blowdown system components in LRA Table 3.4-1. In LRA Table 3.4-2, the applicant identified the component group designation along with its (1) material, (2) environment, (3) aging effects, and (4) AMPs.

As described in Section 2.3.4.11, the steam generator blowdown system continuously purges the steam generators of concentrated impurities, thereby maintaining secondary side steam generator water chemistry. This system is nonnuclear, safety-related except for the portion inside the reactor building, up to and including the containment isolation valves.

Aging Effects:

LRA Tables 3.4-1 and 3.4-2 identify the following applicable aging effects for the steam generator blowdown system:

- loss of material due to general (carbon steel only), pitting, and crevice corrosion of carbon and stainless steel components in treated water and steam environments

- loss of material due to general corrosion of carbon and low-alloy steel components (external surfaces) in air, moisture, and humidity environments

- wall thinning due to flow-accelerated corrosion of carbon steel components in steam and treated water environments

- loss of material due to boric acid corrosion of carbon steel components (external surfaces) in air, leaking, and dripping chemically treated borated water environments

Aging Management Programs:

The following AMPs are utilized to manage aging effects to the steam generator blowdown system:

- Chemistry Program
- Inspections for Mechanical Components Program
- Maintenance Rule Structures Program
- Flow-Accelerated Corrosion Monitoring Program
- Boric Acid Corrosion Surveillances Program

A description of these AMPs is provided in Appendix B of the LRA. The applicant indicated that the effects of aging associated with the components of the steam generator blowdown system will be adequately managed by these AMPs such that there is reasonable assurance that the intended functions will be maintained consistent with the CLB during the period of extended operation.

Staff Evaluation

In addition to Section 3.4 of the LRA, the staff reviewed the pertinent information provided in Section 2.3.4, "Steam and Power Conversion Systems," and the applicable AMP descriptions provided in Appendix B of the LRA to determine whether the aging effects for the steam generator blowdown system components have been properly identified and will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

This section of the SER provides the staff's evaluation of the applicant's AMR for the aging effects and the appropriateness of the programs credited for the aging management of the steam generator blowdown system components at VCSNS. The staff's evaluation includes a review of the aging effects considered and the basis for the applicant's elimination of certain aging effects. In addition, the staff has evaluated the appropriateness of the AMPs that are credited for managing the identified aging effects for the steam generator blowdown system components.

Aging Effects:

The component groups identified in LRA Table 2.3.47 for the steam generator blowdown system are pipe and valves. The staff reviewed the aging effects identified in LRA Tables 3.4-1 and 3.4-2 for these component groups and finds the applicant properly identified the aging effects for these component groups. The aging effects are listed in SER Section 3.4.2.4.11.

The aging effects identified in the LRA for the steam generator blowdown system are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs:

The following AMPs are utilized to manage aging effects to the steam generator blowdown system:

- Chemistry Program
- Inspections for Mechanical Components Program
- Maintenance Rule Structures Program
- Flow-Accelerated Corrosion Monitoring Program
- Boric Acid Corrosion Surveillances Program

Each of the above AMPs (except the Flow-Accelerated Corrosion Monitoring AMP) is credited with managing the aging of several components in different structures and systems and are, therefore, considered common AMPs. The staff review of the common AMPs is presented in Section 3.0.3 of this SER. The Flow-Accelerated Corrosion Monitoring Program is credited with managing aging effects in the SPC systems only and is, therefore, considered a plant-specific AMP. Staff review of the Flow-Accelerated Corrosion Monitoring Program is discussed in Section 3.4.2.3.1 of this SER.

In Table 2.3-47 of the LRA, the applicant did not include the blowdown system heat exchangers as requiring aging management. These heat exchangers are identified as within the scope of license renewal on the applicant's Drawing D-302-771. The staff issued RAI 3.4-5, requesting the applicant to explain why these heat exchangers are not included in Table 2.3-47 of the LRA and to describe the aging management for these heat exchangers.

In its response by letter dated June 12, 2003, the applicant stated that the heat exchangers shown on Drawing D-302-771 are not the steam generator blowdown system heat exchangers. They are the steam generator blowdown sample coolers. These coolers are in the nuclear sampling system and aging management for these coolers is discussed in Section 2.3.3.16 and Table 2.3-30 of the LRA.

The staff finds the applicant's response to RAI 3.4-5, reasonable and acceptable because it provides an explanation that aging management of the steam generator blowdown sample coolers are included in the nuclear sampling system discussed in Section 2.3.3.16 and Table 2.3-30 of the LRA.

On the basis of its review, the staff finds that the AMPs credited in the LRA for the steam generator blowdown system components will effectively manage or monitor the aging effects identified in the LRA.

<u>Conclusions</u>

On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent

with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.4.12 Electro-Hydraulic Control System

As described in Section 2.3.4.12, the electro-hydraulic control system actuates and controls the steam valves. This system is completely separated from the bearing oil supply. During normal plant operation, reactor power is controlled to match turbine load as measured by turbine first stage pressure. The turbine electro-hydraulic control system establishes the desired turbine steady-state load. This system provides turbine trip signals that have license renewal functions of ATWS mitigation and main steam isolation (when used in conjunction with components from various other systems) for a steam line break coincident with failure of a main steam isolation valve.

The applicant's screening review concluded that the electro-hydraulic control system does not perform any intended functions for license renewal. Therefore, none of the electro-hydraulic control system components are subject to an AMR.

Staff review of the scoping and screening process in LRA Section 2.3.4.12 concluded that no electro-hydraulic control system components are subject to an AMR.

3.4.2.4.13 Generic RAI Issues

RAI 3.4-9

In Tables 2.3.38 through 2.3.47 of the LRA, the applicant identifies "valves (body only)" in the "component" column. The GALL Report recommends that the aging effects identified in these tables, except for wall thinning due to FAC, are applicable to both the valve body and bonnet. The staff issued RAI 3.4-9, requesting the applicant to explain why the valve bonnets are not affected by these aging effects or to provide aging management for the bonnets.

In its response by letter dated June 12, 2003, the applicant stated that the choice of words, "valves (body only)" comes from 10 CFR 54.21(a)(1)(a)(1)(i). As defined in the body of technical work for the IPA (available on site for inspection) "valves (body only)" refers to body and bonnet.

The staff finds the applicant's response to RAI 3.4-9, reasonable and acceptable because it provides an explanation that valve bonnets are included as part of the valve body.

RAI 3.4-10

In Table 3.4-1, Item 6 of the LRA, the applicant stated in the "discussion" column of the Flow-Accelerated Corrosion Monitoring Program that the component/component type AMR results for VCSNS are consistent with the GALL Report in material, environment, aging effects, and program. In the GALL Report, aging management for FAC is specified for all steam and power conversion systems piping, fitting, pump casings, and valve bodies. In Tables 2.3-38 and 2.3-40, the LRA does not identify aging management for FAC for piping, fitting, pump casings, and valve bodies in the auxiliary boiler and feedwater system and the emergency feedwater system. Also, in Table 2.3-44, the LRA does not identify aging management for FAC for the

main steam system pump turbine (casing only). The staff issued RAI 3.4-10, requesting the applicant to explain why the LRA states it is consistent with the GALL Report but does not include the above components in the Flow-Accelerated Corrosion Monitoring Program.

In its response by letter dated June 12, 2003, the applicant stated that EPRI considers that FAC is not an aging effect requiring evaluation in systems that are either highly oxygenated, superheated, single-phase flow below 200 °F, or operated less than 2 percent of the time. The portion of the auxiliary boiler and feedwater system in scope for license renewal only supplies steam to the evaporators and to the boric acid batch add tank. The evaporators are rarely used and the batch add tank rarely requires steam. Steam flows less than 2 percent of the time in this line. Therefore, loss of material due to FAC is not an aging effect requiring management for the auxiliary boiler and feedwater system. The process fluid of the emergency feedwater system is less than 200 °F; therefore, loss of material due to FAC is not an aging effect requiring management for the emergency feedwater system. The component identified in Table 2.3-44 of the LRA as the main steam system pump turbine (casing only) is the turbine driven emergency feedwater pump casing. This pump is operated less than 2 percent of the time. Therefore, loss of material due to FAC is not an aging effect requiring management for the turbine driven emergency feedwater pump casing.

The staff finds the applicant’s response to RAI 3.4-10, reasonable and acceptable because it provides an explanation why the above components are not managed for loss of material due to FAC.

RAI 3.4-15

The GALL Report recommends a one-time inspection to verify the effectiveness of the Water Chemistry Program for all components except those in the main steam system. The staff issued RAI 3.4-15, requesting the applicant to explain why a one-time inspection is not performed to verify the effectiveness of the Chemistry Program for auxiliary boiler steam and feedwater system components in Table 2.3-38, gland sealing steam system components in Table 2.3-43, main steam dump system components in Table 2.3-45, and turbine cycle sampling system components in Table 2.3-46.

In its response by letter dated June 12, 2003, the applicant stated that the only license renewal function of the gland sealing, main steam dump, and turbine cycle sampling systems is to provide a means of main steam isolation (when used in conjunction with components from various other systems) for a steam line break coincident with failure of the main steam isolation valve. The components of these systems provide this function in the main steam system environment; therefore, a one-time inspection is not required. The portion of the auxiliary boiler and feedwater system in scope for license renewal supplies steam to the evaporators and the boric acid batch add tank in the auxiliary building. The normal supply for this steam is from the reheat steam system through a desuperheating valve which converts superheated steam to a high quality saturated steam for use in these components. Thus, the steam originates from the main steam system, passes through the high pressure turbine generator, then through the moisture separator reheater where moisture is removed and the steam is superheated for use in the low pressure turbines. A portion of the steam leaving the moisture separator reheater is converted by the desuperheater to saturated steam for use in the evaporators and the boric acid batch add tank. Because the steam originates as high purity steam in the main steam system and is further reheated in the moisture separator reheaters, the environment of the in-

scope portion of the auxiliary boiler and feedwater system should be considered as pure as the environment of the main steam system; therefore, a one-time inspection is not required.
The staff finds the applicant's response to RAI 3.4-15, reasonable and acceptable because it provides an explanation that the above components are located in a main steam environment; therefore a one-time inspection is not required to verify the effectiveness of the Chemistry Program.

3.5 Containment, Structures, and Component Supports

This section addresses the aging management of the containment, structures, and component supports. The structures that make up this group are described in the following LRA sections:

- Reactor Building (Containment and Internal Structures) (2.4.1)
- Auxiliary Building (2.4.2.1)
- Control Building (2.4.2.2)
- Diesel Generator Building (2.4.2.3)
- Fuel Handling Building (2.4.2.4)
- Intermediate Building (2.4.2.5)
- Turbine Building (2.4.2.6)
- Service Water Pumphouse (2.4.2.7.1)
- Service Water Intake and Discharge Structures (2.4.2.7.2)
- Condensate Storage Tank Foundation—Yard Structure (2.4.2.8.1)
- Fire Service Pumphouse—Yard Structure (2.4.2.8.2)
- Electrical Manhole MH-2—Yard Structure (2.4.2.8.3)
- Earthen Embankments (North Berm, Service Water Pond Dams) (2.4.2.8.4)
- Electrical Substation and Transformer Area—Yard Structures (2.4.2.8.5)

The applicant did not address component supports as a separate structural group, but as structural component types within each of the structures listed above. LRA Section 3.5.1.11 describes the Class 1 component supports. With this exception, there is no specific description of component supports.

LRA Table 2.4-1 presents a listing of the intended functions applicable to containment, structures, and structural components. For each of the structures in the license renewal scope, LRA Tables 2.4-2 through 2.4-14 list the applicable structural component types, the applicable intended function(s), and a reference to the AMR results that are summarized in LRA Section 3.5, Tables 3.5-1 and 3.5-2.

LRA Table 3.5-1 duplicates NUREG-1800 Table 3.5-1, with an added "Discussion" column. The discussion column summarizes the results of the applicant's plant-specific AMR for the structures and structural components that are generically evaluated in the GALL Report. LRA Table 3.5-2 covers plant-specific structures and structural components that are different from or not addressed in the GALL Report, but are relied on for license renewal by the applicant. The discussion column summarizes the results of the applicant's plant-specific AMR for these structures and structural components.

3.5.1 Summary of Technical Information in the Application

3.5.1.1 Description of Containment, Structures, and Component Supports

LRA Section 3.5.1 contains brief descriptions of the containment, structures, and component supports subject to AMR. These descriptions are consistent with, but not identical to, the descriptions in LRA Sections 2.4.1 and 2.4.2. In two cases, additional descriptive information is included in LRA Section 3.5.1, and augments the descriptions in LRA Section 2.4.

LRA Section 3.5.1.2 describes the auxiliary building. There are some differences when compared to the description in LRA Section 2.4.2.1. The text of LRA Section 3.5.1.2 is as follows:

> The Auxiliary Building superstructure is a reinforced concrete shear wall (box type) structure containing five main floor levels above the foundation and extending up to elevation 485'-0" (designated as the roof). Above this level is another story composed primarily of a metal clad structural steel braced frame, but with limited areas continuing the reinforced concrete construction employed below. The foundation is comprised of a reinforced concrete structural mat which is supported on fill concrete down to competent bedrock. A waterproofing membrane is provided between the structural mat concrete and fill concrete because of the depth of the foundation below the ground water table.

This description includes additional detail about the structure above elevation 485'-0", and also indicates that the bottom of the foundation is below the groundwater table.

LRA Section 3.5.1.11 describes the Class 1 component supports. This section has no counterpart in LRA Section 2.4. The text of LRA Section 3.5.1.11 is as follows:

> Class 1 Component Supports are those supports for major equipment and Class 1 piping that are subject to aging management review including: Class 1 piping supports and major equipment supports (pressurizer base flange and upper lateral supports; reactor vessel supports; steam generator vertical, lower lateral, and upper lateral supports; and reactor coolant pump lateral and vertical support assemblies).

The passive, long-lived structural component types in these structures, that are subject to an AMR, were previously identified in LRA Tables 2.4-2 through 2.4-14. Tables 2.4-2 through 2.4-14 reference specific item numbers in LRA Tables 3.5-1 and 3.5-2. Tables 3.5-1 and 3.5-2 summarize the results of the applicant's AMR for the containment, structures, and component supports at VCSNS, and also identify the AMPs and activities that manage aging. Descriptions of the AMPs and activities, including site-specific operating experience, are contained in LRA Appendix B.

3.5.1.2 Aging Management Review Methodology

LRA Section 3.5.2 summarizes the applicant's AMR methodology, and its review of site-specific and industry operating experience. The applicant's AMR of containment, structures, and component supports considered the materials, environments, and stressors that are associated with each structure, component, or commodity grouping under review. The methodology follows the approach recommended in NEI 95-10 and is based on generic industry guidance for determining aging effects for both mechanical and civil/structural components. The applicant reviewed the guidance for applicability to the VCSNS materials of construction, and component internal and external operating environments, and utilized it to identify aging effects for components, structures, and commodities. The evaluation of materials and environment combinations resulted in the identification of the aging effects; if the identified aging effects

adversely affect intended functions, then the aging effects require management for the applicable components and commodities.

The applicant correlated aging effects that require management to AMPs. The AMR identified one or more AMPs to be used to demonstrate that the effects of aging will be managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation. The programs identified for managing the effects of aging were compared to those listed in NUREG-1801 and evaluated for consistency with NUREG-1801 programs that are relied on for license renewal. The results are documented and discussed in LRA Table 3.5-1, using the format in the NRC SRP-LR (NUREG-1800).

The staff's preacceptance review of VCSNS LRA Section 3.5 identified a difficulty in tracking the specific structural component types included in the VCSNS license renewal scope, as delineated in LRA Tables 2.4-2 through 2.4-14, to the applicable aging effects requiring management and to the AMPs credited for managing the aging effects. In response, the applicant submitted Report TR00170-003, Revision 0, Attachment II: Aging Management Review Results for Structures and Structural Components. Attachment II contains 10-column formatted tables that identify each structural component type, its intended function(s), material, environment, aging effect(s), AMP(s), consistency with the NUREG-1801 AMP(s), and applicable notes. This supplementary submittal resolves the staff's concern.

3.5.1.3 Operating Experience Review

The applicant's AMR in LRA Section 3.5.2 included an evaluation of site-specific and industry operating experience. The site-specific evaluation included a review of (1) Corrective Action Program, (2) license event reports, (3) Maintenance Rule Data Base, and (4) interviews with systems engineers. The applicant stated that this review did not identify any additional aging effects requiring management beyond those identified using the methods described in NEI 95-10.

The applicant conducted a review of industry operating experience published since the effective date of NUREG-1801, to identify any additional aging effects requiring management. This review did not identify any additional aging effects requiring management beyond those previously identified.

The applicant's ongoing review of plant-specific and industry-wide operating experience is conducted in accordance with the plant Operating Experience Program.

The applicant has documented plant-specific operating experience primarily under the "Operating Experience" attribute of the AMP evaluations in LRA Appendix B. Some operating experience is also summarized in LRA Tables 3.5-1 and 3.5-2, in the "Discussion" column, and in Report TR00170-003, Attachment II — Aging Management Review Results for Structures and Structural Components, in the "Notes" column. The staff evaluation of plant-specific operating experience is included in SER Section 3.5.2.3, Aging Management Programs.

3.5.2 Staff Evaluation

In Section 3.5 of the LRA, the applicant described its AMR for structures and structural components at VCSNS. The staff reviewed LRA Section 3.5 to determine whether the applicant has provided sufficient information to demonstrate that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB throughout the period of extended operation, in accordance with the requirements of 10 CFR 54.21(a)(3), for structures and structural components that are determined to be within the scope of license renewal and subject to an AMR.

The applicant referenced the GALL Report in its AMR. The staff has previously evaluated the adequacy of the aging management of structures and structural components for license renewal as documented in the GALL Report. Thus, the staff did not repeat its review of the matters described in the GALL Report, except to ensure that the material presented in the LRA was applicable, and to verify that the applicant had identified the appropriate programs as described and evaluated in the GALL Report. The staff evaluated those aging management issues recommended for further evaluation in the GALL Report. The staff also reviewed aging management information submitted by the applicant that was different from that in the GALL Report or was not addressed in the GALL Report. Finally, the staff reviewed the FSAR supplement to ensure that it provided an adequate description of the programs credited with managing aging for structures and structural components.

In LRA Section 3.5, the applicant provided brief descriptions of the structures and structural components and summarized the results of its AMR of the structures and structural components at VCSNS.

Table 3.5-1 below provides a summary of the staff's evaluation of components, aging effects/mechanisms, and AMPs listed in LRA Section 3.5 that are addressed in the GALL Report.

Table 3.5-1 Staff Evaluation for V.C. Summer Structures and Structural Components in the GALL Report: Common Components of All Types of PWR and BWR Containment

Component Group	Aging Effect/Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
Penetration sleeves, penetration bellows, and dissimilar metal welds (LRA Table 3.5-1, AMR Item 1)	Cumulative fatigue damage (CLB fatigue analysis exists)	TLAA evaluated in accordance with 10 CFR 54.21(c)	TLAA (4.6) addresses the flat plate closures that comprise the containment pressure boundary at penetrations. Penetration sleeves, penetration bellows, and dissimilar metal welds are on the outside of the penetrations and are not part of the containment pressure boundary.	Consistent with GALL. GALL recommends further evaluation. (See Section 3.5.2.2.1 Cumulative Fatigue Damage below).

Table 3.5-1 Staff Evaluation for V.C. Summer Structures and Structural Components in the GALL Report: Common Components of All Types of PWR and BWR Containment				
Component Group	**Aging Effect/Mechanism**	**AMP in GALL Report**	**AMP in LRA**	**Staff Evaluation**
Penetration sleeves, bellows, and dissimilar metal welds (LRA Table 3.5-1, AMR Item 2)	Cracking due to cyclic loading, or crack initiation and growth due to SCC	Containment ISI and containment leak rate test	10 CFR Appendix J General Visual Inspection (App. B.1.11); 10 CFR Appendix J Leak Rate Testing (App. B.1.12); Containment ISI Program-IWE/IWL (App. B.1.16).	Consistent with GALL. GALL recommends further evaluation. (See Section 3.5.2.2.1 Cracking below).
Penetration sleeves, penetration bellows, and dissimilar metal welds (LRA Table 3.5-1, AMR Item 3)	Loss of material due to corrosion	Containment ISI and containment leak rate test	10 CFR Appendix J General Visual Inspection (App. B.1.11); 10 CFR Appendix J Leak Rate Testing (App. B.1.12); Containment ISI Program-IWE/IWL (App. B.1.16).	Consistent with GALL. (See Section 3.5.2.1 below).
Personnel airlock and equipment hatch (LRA Table 3.5-1, AMR Item 4)	Loss of material due to corrosion	Containment ISI and Containment leak rate test	10 CFR Appendix J General Visual Inspection (App. B.1.11); 10 CFR Appendix J Leak Rate Testing (App. B.1.12); Containment ISI Program-IWE/IWL (App. B.1.16).	Consistent with GALL. (See Section 3.5.2.1 below).
Personnel airlock and equipment hatch (LRA Table 3.5-1, AMR Item 5)	Loss of leak tightness in closed position due to mechanical wear of locks, hinges, and closure mechanism	Containment leak rate test and Plant Technical Specifications	10 CFR Appendix J General Visual Inspection (App. B.1.11); 10 CFR Appendix J Leak Rate Testing (App. B.1.12); Containment ISI Program-IWE/IWL (App. B.1.16); leak tightness of hatches is governed by VCSNS Tech. Spec. 3/4.6.1.	Consistent with GALL. (See Section 3.5.2.1 below).

Table 3.5-1 Staff Evaluation for V.C. Summer Structures and Structural Components in the GALL Report: Common Components of All Types of PWR and BWR Containment				
Component Group	**Aging Effect/Mechanism**	**AMP in GALL Report**	**AMP in LRA**	**Staff Evaluation**
Seals, gaskets, and moisture barriers (LRA Table 3.5-1, AMR Item 6)	Loss of sealant and leakage through containment due to deterioration of joint seals, gaskets, and moisture barriers	Containment ISI and Containment leak rate test	10 CFR Appendix J General Visual Inspection (App. B.1.11); 10 CFR Appendix J Leak Rate Testing (App. B.1.12); Containment ISI Program-IWE/IWL (App. B.1.16); Maintenance Rule Structures Program (App. B.1.18).	Consistent with GALL. (See Section 3.5.2.1 below).

Table 3.5-1 Staff Evaluation for V.C. Summer Structures and Structural Components in the GALL Report: PWR Concrete (Reinforced and Prestressed) and Steel Containment BWR Concrete (Mark II and III) and Steel (Mark I, II, and III) Containment				
Component Group	**Aging Effect/Mechanism**	**AMP in GALL Report**	**AMP in LRA**	**Staff Evaluation**
Concrete elements: foundation, walls, dome (LRA Table 3.5-1, AMR Item 7)	Aging of accessible and inaccessible concrete areas due to leaching of calcium hydroxide, aggressive chemical attack, and corrosion of embedded steel	Containment ISI	10 CFR Appendix J General Visual Inspection (App. B.1.11); Containment ISI Program-IWE/IWL (App. B.1.16). Plant-specific for inaccessible areas: groundwater and reservoir chemistry monitoring; inspect below-grade concrete when exposed; use periodic inspection of underwater concrete structures as an indicator.	Consistent with GALL. GALL recommends further evaluation. (See Section 3.5.2.2.1 Aging of Inaccessible Concrete Areas below).
Concrete elements: foundation (LRA Table 3.5-1, AMR Item 8)	Cracks, distortion, and increases in component stress level due to settlement	Structures Monitoring	10 CFR Appendix J General Visual Inspection (App. B.1.11); Containment ISI Program-IWE/IWL (App. B.1.16); Maintenance Rule Structures Program (App. B.1.18).	Consistent with GALL. (See Section 3.5.2.2.1 Cracking, Distortion, and Increase in Component Stress Level below).

Table 3.5-1 Staff Evaluation for V.C. Summer Structures and Structural Components in the GALL Report: PWR Concrete (Reinforced and Prestressed) and Steel Containment BWR Concrete (Mark II and III) and Steel (Mark I, II, and III) Containment				
Component Group	**Aging Effect/Mechanism**	**AMP in GALL Report**	**AMP in LRA**	**Staff Evaluation**
Concrete elements: foundation (LRA Table 3.5-1, AMR Item 9)	Reduction in foundation strength due to erosion of porous concrete subfoundation	Structures Monitoring	Not applicable. VCSNS does not use porous concrete and does not have a dewatering system.	Consistent with GALL. (See Section 3.5.2.2.1 Cracking, Distortion, and Increase in Component Stress Level below).
Concrete elements: foundation, dome, and wall (LRA Table 3.5-1, AMR Item 10)	Reduction of strength and modulus due to elevated temperature	Plant-specific	Not applicable. VCSNS containment concrete is not exposed to elevated temperature.	Consistent with GALL. GALL recommends further evaluation. (See Section 3.5.2.2.1 Reduction of Strength and Modulus of Concrete Structures below).
Prestressed containment: tendons and anchorage components (LRA Table 3.5-1, AMR Item 11)	Loss of prestress due to relaxation, shrinkage, creep, and elevated temperature	TLAA evaluated in accordance with 10 CFR 54.21(c)	TLAA per 10 CFR 54.3 (4.5); Tendon Surveillance Program (App.B.3.3); Containment ISI Program-IWE/IWL (App. B.1.16).	Consistent with GALL. GALL recommends further evaluation. (See Section 3.5.2.2.1 Loss of Prestress below).
Steel elements: liner plate, containment shell (LRA Table 3.5-1, AMR Item 12)	Loss of material due to corrosion in accessible and inaccessible areas	Containment ISI and Containment leak rate test	10 CFR Appendix J General Visual Inspection (App. B.1.11); 10 CFR Appendix J Leak Rate Testing (App. B.1.12); Containment ISI Program-IWE/IWL (App. B.1.16); Containment Coating Monitoring and Maintenance Program (App.B.1.15).	Consistent with GALL. GALL recommends further evaluation. (See Section 3.5.2.2.1 Loss of Material below).
Steel elements: vent header, drywell head, torus, downcomers, pool shell	Cumulative fatigue damage (CLB fatigue analysis exists)	TLAA evaluated in accordance with 10 CFR 54.21(c)	Not applicable.	BWR

Table 3.5-1 Staff Evaluation for V.C. Summer Structures and Structural Components in the GALL Report: PWR Concrete (Reinforced and Prestressed) and Steel Containment BWR Concrete (Mark II and III) and Steel (Mark I, II, and III) Containment				
Component Group	**Aging Effect/Mechanism**	**AMP in GALL Report**	**AMP in LRA**	**Staff Evaluation**
Steel elements: protected by coating (LRA Table 3.5-1, AMR Item 13)	Loss of material due to corrosion in accessible areas only	Protective coating monitoring and maintenance	10 CFR Appendix J General Visual Inspection (App. B.1.11); Containment Coating Monitoring and Maintenance Program (App.B.1.15); Containment ISI Program-IWE/IWL (App. B.1.16); Maintenance Rule Structures Program (App. B.1.18).	Consistent with GALL. (See Section 3.5.2.1 below).
Prestressed containment: tendons and anchorage components (LRA Table 3.5-1, AMR Item 14)	Loss of material due to corrosion of prestressing tendons and anchorage components	Containment ISI	Containment ISI Program-IWE/IWL (App. B.1.16); Tendon Surveillance Program (App.B.3.3)	Consistent with GALL. (See Section 3.5.2.1 below).
Concrete elements: foundation, dome, and wall (LRA Table 3.5-1, AMR Item 15)	Scaling, cracking, and spalling due to freeze-thaw; expansion and cracking due to reaction with aggregate	Containment ISI	10 CFR Appendix J General Visual Inspection (App. B.1.11); Containment ISI Program-IWE/IWL (App. B.1.16); Maintenance Rule Structures Program (App. B.1.18).	Consistent with GALL. (See Section 3.5.2.1 below).
Steel elements: vent line bellows, vent headers, downcomers	Cracking due to cyclic loads or crack initiation and growth due to SCC	Containment ISI and Containment leak rate test	Not applicable.	BWR
Steel elements: suppression chamber liner	Crack initiation and growth due to SCC	Containment ISI and Containment leak rate test	Not applicable.	BWR
Steel elements: drywell head and downcomer pipes	Fretting and lock up due to wear	Containment ISI	Not Applicable	BWR

Table 3.5-1 Staff Evaluation for V.C. Summer Structures and Structural Components in the GALL Report: Class I Structures				
Component Group	**Aging Effect/Mechanism**	**AMP in GALL Report**	**AMP in LRA**	**Staff Evaluation**
All groups except Group 6: accessible interior/exterior concrete & steel components (LRA Table 3.5-1, AMR Item 16)	All types of aging effects	Structures Monitoring	Containment Coating Monitoring and Maintenance Program (App.B.1.15); Containment ISI Program-IWE/IWL (App. B.1.16); Maintenance Rule Structures Program (App. B.1.18).	Consistent with GALL. (See Section 3.5.2.2.2 below).
Groups 1-3, 5, 7-9: inaccessible concrete components, such as exterior walls below grade and foundation (LRA Table 3.5-1, AMR Item 17)	Aging of inaccessible concrete areas due to aggressive chemical attack and corrosion of embedded steel	Plant-specific	Plant-specific: groundwater and reservoir chemistry monitoring; inspect below-grade concrete when exposed; use periodic inspection of underwater concrete structures as an indicator.	Consistent with GALL. GALL recommends further evaluation. (See Section 3.5.2.2.2 below).
Group 6: all accessible/inaccessible concrete, steel and earthen components (LRA Table 3.5-1, AMR Item 18)	All types of aging effects, including loss of material due to abrasion, cavitation, and corrosion	Inspection of Water-Control Structures or FERC/US Army Corps of Engineers dam inspections and maintenance	Maintenance Rule Structures Program (App. B.1.18); Service Water Pond Dam Inspection Program (App. B.1.21); Service Water Structures Survey Monitoring Program (App. B.1.22); Underwater Inspection Program (SWIS and SWPH) (App. B.1.23);	Consistent with GALL. (See Section 3.5.2.1 below).
Group 5: liners (LRA Table 3.5-1, AMR Item 19)	Crack initiation and growth from SCC and loss of material due to crevice corrosion	Water Chemistry Program and Monitoring of spent fuel pool water level	Chemistry Program (App. B.1.4); Maintenance Rule Structures Program (App. B.1.18); Tech. Spec. 3/4.7.10 requires verification of pool water level on a continuous basis.	Consistent with GALL. (See Section 3.5.2.1 below).
Group 1-3, 5, 6: all masonry block walls (LRA Table 3.5-1, AMR Item 20)	Crack due to restraint, shrinkage, creep, and aggressive environment	Masonry Wall	Maintenance Rule Structures Program (App. B.1.18).	Consistent with GALL. (See Section 3.5.2.1 below).

Table 3.5-1 Staff Evaluation for V.C. Summer Structures and Structural Components in the GALL Report: Class I Structures				
Component Group	**Aging Effect/Mechanism**	**AMP in GALL Report**	**AMP in LRA**	**Staff Evaluation**
Group 1-3, 5, 7-9: foundation (LRA Table 3.5-1, AMR Item 21)	Cracks, distortion, and increases in component stress level due to settlement	Structures Monitoring	Maintenance Rule Structures Program (App. B.1.18)	Consistent with GALL. (See Section 3.5.2.2.1 Cracking, Distortion, and Increase in Component Stress Level below).
Group 1-3, 5-9: foundation (LRA Table 3.5-1, AMR Item 22)	Reduction in foundation strength due to erosion of porous concrete subfoundation	Structures Monitoring	Not applicable. VCSNS does not use porous concrete and does not have a dewatering system.	Consistent with GALL. (See Section 3.5.2.2.1 Cracking, Distortion, and Increase in Component Stress Level below).
Group 1-5: concrete (LRA Table 3.5-1, AMR Item 23)	Reduction of strength and modulus due to elevated temperature	Plant-specific	Not applicable. VCSNS Class I structures concrete is not exposed to elevated temperature.	Consistent with GALL. GALL recommends further evaluation. (See Section 3.5.2.2.1 Reduction of Strength and Modulus of Concrete Structures below).
Groups 7, 8: liners (LRA Table 3.5-1, AMR Item 24)	Crack initiation and growth due to SCC; Loss of material due to crevice corrosion	Plant-specific	Concrete tanks are not used at VCSNS; applicant states that aging effect is not applicable to VCSNS steel tanks. In the mechanical systems AMR, Above Ground Tank Inspection (App. B.2.1) is credited for one-time inspection of carbon steel and stainless steel tank internal surfaces.	GALL recommends further evaluation. (See Section 3.5.2.4 below).

Table 3.5-1 Staff Evaluation for V.C. Summer Structures and Structural Components in the GALL Report: Component Supports				
Component Group	**Aging Effect/Mechanism**	**AMP in GALL Report**	**AMP in LRA**	**Staff Evaluation**
All Groups: support members: anchor bolts, concrete surrounding anchor bolts, welds, grout pad, bolted connections, etc. (LRA Table 3.5-1, AMR Item 25)	Aging of component support	Structures Monitoring	Maintenance Rule Structures Program (App. B.1.18); 10 CFR Appendix J General Visual Inspection (App. B.1.11).	Consistent with GALL. (See Section 3.5.2.2.3 below).
Groups B1.1, B1.2, and B1.3: support members: anchor bolts, welds (LRA Table 3.5-1, AMR Item 26)	Cumulative fatigue damage (CLB fatigue analysis exists)	TLAA evaluated in accordance with 10 CFR 54.21(c)	Not applicable	Consistent with GALL. GALL recommends further evaluation. (See Section 3.5.2.2.3 below).
All Groups: support members: anchor bolts, welds (LRA Table 3.5-1, AMR Item 27)	Loss of material due to boric acid corrosion	Boric acid corrosion	Boric Acid Surveillances (App. B.1.2); Maintenance Rule Structures Program (App. B.1.18); 10 CFR Appendix J General Visual Inspection (App. B.1.11)	Consistent with GALL. (See Section 3.5.2.1 below)
Groups B1.1, B1.2, and B1.3: support members: anchor bolts, welds, spring hangers, guides, stops, and vibration isolators (LRA Table 3.5-1, AMR Item 28)	Loss of material due to environmental corrosion; loss of mechanical function due to corrosion, distortion, dirt, overload, etc.	ISI	Maintenance Rule Structures Program (App. B.1.18); 10 CFR Appendix J General Visual Inspection (App. B.1.11); ASME Section XI ISI Program-IWF (App. B.1.13)	Consistent with GALL. (See Section 3.5.2.1 below).
Group B1.1: high strength low-alloy bolts (LRA Table 3.5-1, AMR Item 29)	Crack initiation and growth due to SCC	Bolting integrity	ASME Section XI ISI Program-IWF (App. B.1.13); Applicant justified that this aging effect is not applicable to VCSNS.	Not consistent with GALL. (See Section 3.5.2.4 below).

The staff's review of the VCSNS structural components is contained within four sections of this SER. Section 3.5.2.1 is the staff review of structures and structural components that the applicant indicates are consistent with GALL and for which GALL does not require further evaluation. Section 3.5.2.2 is the staff review of structures and structural components that the applicant indicates are consistent with GALL and for which GALL recommends further evaluation. Section 3.5.2.3 is the staff evaluation of the AMPs that are specific to the aging

management of structural components. Section 3.5.2.4 contains an evaluation of the adequacy of aging management for components in each structure and includes an evaluation of structures and structural components that the applicant indicates are not in GALL.

3.5.2.1 Aging Management Evaluations in the GALL Report That Are Relied On For License Renewal, Which Do Not Require Further Evaluation

Table 3.5-1 indicates that all except one of the LRA Table 3.5-1 AMR items for which GALL does not require further evaluation were found to be consistent with GALL. The staff reached these conclusions after review of the applicant's RAI responses. The exception is AMR Item 29, related to SCC of high-strength bolting for component supports. While not consistent with GALL, the staff accepts the applicant's AMR, which concluded that this aging effect is not applicable to VCSNS. The staff's evaluation of this issue is in SER Section 3.5.2.3.3.

For component groups evaluated in GALL for which the applicant has claimed consistency with GALL, and for which GALL does not recommend further evaluation, the staff sampled components in these groups to determine whether the plant-specific components contained in these GALL component groups were bounded by the GALL evaluation. The staff also sampled component groups to determine whether the applicant had properly identified those component groups in GALL that were not applicable to its plant. The staff also identified several areas where additional information or clarification was needed. The staff's evaluation of applicant's responses to those RAI's is included in Sections 3.5.2.2, 3.5.2.3, and 3.5.2.4 of this SER.

On the basis of its review, the staff has verified the applicant's claim of consistency with the GALL report. The staff finds that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.2 Aging Management Evaluations in the GALL Report That Are Relied On For License Renewal, For Which GALL Recommends Further Evaluation

For component groups evaluated in the GALL Report for which the applicant has claimed consistency with GALL, and for which the GALL Report recommends further evaluation, the staff reviewed the applicant's evaluation to determine whether it adequately addressed the issues for which GALL recommended further evaluation. In addition, the staff sampled components in these groups to determine whether the plant-specific components contained in these GALL component groups were bounded by the GALL evaluation.

The Gall Report indicates that further evaluation should be performed for the items described in the following sections:

3.5.2.2.1 Containment

<u>Aging of Inaccessible Concrete Areas</u>

As stated in the SRP-LR, the GALL Report recommends further evaluation to manage the aging effects for containment concrete components located in inaccessible areas, if the aging mechanisms of (1) leaching of calcium hydroxide, (2) aggressive chemical attack, or (3)

corrosion of embedded steel are significant. Possible aging effects for containment concrete structural components due to these three aging mechanisms are cracking, change in material properties, and loss of material.

The AMP recommended by the GALL Report for managing the above aging effects for containment concrete components in accessible portions of the containment structures is the ASME Section XI, Subsection IWL (XI.S2) Program. The staff's evaluation of the applicant's ASME Section XI, Subsection IWL AMP is in Section 3.5.2.3.6 of this SER.

Subsection IWL exempts from examination those portions of the concrete containment that are inaccessible (e.g., foundation, below-grade exterior walls, concrete covered by liner). For inaccessible portions of the containment structure, 10 CFR 50.55a(b)(2)(ix) requires that the licensee evaluate the acceptability of inaccessible areas when conditions exist in accessible areas that could indicate the presence of, or result in, degradation to inaccessible areas.

The applicant addressed the specific criteria defined in the GALL Report, regarding the need for further evaluation to manage the potential aging of containment concrete structural components in inaccessible areas in LRA Table 3.5-1. The GALL Report recommends further evaluation for containment concrete in inaccessible areas if the aging mechanism's (1) leaching of calcium hydroxide, (2) aggressive chemical attack, or (3) corrosion of embedded steel are significant. In LRA Table 3.5-1, AMR item 7, the applicant stated that —

> The VCSNS containment structure is not exposed to flowing water and designed in accordance with ACI-318 and constructed in accordance with ACI-301 and ASTM Standards, which provide a good quality, dense, low permeability concrete.
>
> The water chemical analysis results confirm that the site groundwater is mildly acidic but considered to be non-aggressive.

Further, the applicant concluded that —

> Inaccessible areas at VCSNS do not require a plant-specific aging management for leaching of calcium hydroxide, aggressive chemical attack or corrosion of embedded steel.

The staff position is that inaccessible concrete components (i.e., below grade) require aging management unless specific criteria defined in NUREG-1801, GALL Volume 2, are satisfied to demonstrate a nonaggressive below-grade environment. As part of RAI 3.5-2, the staff requested the following information:

(c) Submit a quantitative assessment of the below-grade environment, comparing it to the specific criteria defined in GALL Volume 2.

(d) If it is nonaggressive, based on satisfaction of the specific criteria defined in GALL Volume 2, describe the groundwater monitoring program that will be implemented to verify that the below-grade environment remains nonaggressive, including monitoring frequency and consideration of seasonal fluctuations.

(e) If the below-grade environment does not satisfy the specific criteria defined in GALL Volume 2, describe in detail the plant-specific AMPs for inaccessible concrete components.

In its initial response to RAI 3.5-2, parts (c), (d), and (e), the applicant stated the following:

> (c) Section 6.1 (Table 6.1-3) of TR00170-003 provides the quantitative assessment of the below-grade groundwater environment at VCSNS. These analyses results are based on samples taken in 2001 from three (3) wells in the general vicinity of plant structures. [Note that prior sample analyses for chlorides, sulfates and pH do not exist.] Groundwater chlorides (from all three wells) were determined to be < 10 ppm, which is well within the GALL defined limits of < 500 ppm. Groundwater sulfates (from all three wells) were determined to be < 10 ppm, which is well within the GALL defined limits of < 1500 ppm. Groundwater pH (from the three wells) was determined to range from 4.8 to 5.3, which marginally exceeds the GALL defined limits of 5.5. Based on these results, the VCSNS Application defines the site groundwater as non-aggressive, although mildly acidic.
>
> (d) Application Table 3.5-1, Item 17 specifies that periodic monitoring of the below-grade water chemistry will be conducted during the period of extended operation to demonstrate that the below-grade environment is not aggressive. VCSNS Engineering Services Procedure (Inspections for Maintenance Rule - Structures) will be revised to include a chemical analysis of raw water (including groundwater) on a 5-year interval to coincide with the Maintenance Rule Structures Inspections. [Note that seasonal fluctuations are not applicable at VCSNS since the level of groundwater remains relatively constant due to the influence of Monticello Reservoir.]
>
> (e) Application Table 3.5-1, Items 7 and 16, discusses aging mechanisms and effects for inaccessible concrete. Since the VCSNS below grade environment marginally exceeds the specific pH criteria defined in GALL, the concrete design was further reviewed and determined to provide protection against aggressive chemical attack. Since the below-grade structures are considered to be resistant to the mildly acidic environment, plant specific aging management programs are not required for inaccessible concrete areas.

The staff position is that any deviation from the specific criteria defined in GALL Volume 2 constitutes an aggressive environment, and aging management of inaccessible concrete is necessary.

In its supplemental response to RAI 3.5-2, the applicant committed to a plant-specific program to manage aging of inaccessible concrete:

> The NRC Staff position is that the VCSNS groundwater is considered to be aggressive since it has a pH < 5.5. In order to satisfy this concern, the following provisions will be incorporated as part of existing plant programs and procedures:
>
> 3. The site excavation and backfill procedure will be revised to include a concrete surface inspection by engineering personnel if soil is removed adjacent to any concrete structure surfaces at or below the nominal groundwater elevation of 423'.
>
> 4. As noted in response to RAI 3.5-2(d), chemical analysis of groundwater will be conducted on a 5-year interval to coincide with the Maintenance Rule Structures Inspection Program. This analysis will also include a water sample from the Service Water Pond.
>
> 5. Underwater diver's inspections of the Service Water Intake Structure (tunnel) will continue as described in response to RAI 3.5-26. These inspections will provide additional assurance of the integrity of concrete structures exposed to below water conditions.

Since the applicant's program is consistent with programs previously accepted by the staff to address this issue, the staff finds it acceptable.

On the basis of its review, the staff finds that the applicant appropriately evaluated AMR results involving management of aging of inaccessible concrete areas for containment, as recommended in the GALL report. Since the applicant's AMR results are otherwise consistent with the GALL report, the staff finds that the applicant has demonstrated that the effects of

aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

Cracking, Distortion, and Increase in Component Stress Level Due to Settlement; Reduction of Foundation Strength Due to Erosion of Porous Concrete Subfoundations, If Not Covered by Structures Monitoring Program

As stated in the SRP-LR, for the containment foundation, the GALL Report recommends further evaluation of the aging effects of (1) cracking due to settlement and (2) change in material properties as manifested by a reduction of foundation strength due to erosion of the porous concrete subfoundation, if these two effects are not covered by a structures monitoring AMP. In addition, the GALL Report recommends verification of the continued functionality of a dewatering system during the license renewal period, if relied on by the applicant to lower the site groundwater level.

The applicant addressed the above criteria defined in the GALL Report, regarding the need for further evaluation to manage the potential aging of the containment foundation in LRA Table 3.5-1, AMR Items 8 and 9.

Under AMR Item 8, the applicant credits three AMPs, including its Maintenance Rule Structures Program (B.1.18), to manage the aging effects due to settlement. However, the applicant also stated —

> The VCSNS containment foundation is constructed directly on competent bedrock and is not subject to settlement; therefore, aging management is not required.

Under AMR item 9, the applicant stated —

> The VCSNS containment foundation does not use porous concrete and is not subject to flowing water; therefore, aging management is not required.

The staff noted that in LRA Section 3.5.1.2, the applicant indicates that the foundation for the auxiliary building extends below the groundwater level and is supported on fill concrete down to competent bedrock. The applicant does not identify whether underdrain (dewatering) systems are utilized at VCSNS for the auxiliary building or any other buildings in the license renewal scope, and no intended functions have been identified for the fill concrete used under several of the buildings included in the license renewal scope. In RAI 3.5-6, the staff requested the applicant to submit the following information related to underdrain systems and fill concrete:

(a) Identify whether underdrain (dewatering) systems are utilized at VCSNS.

(b) If utilized, describe the specific applications; describe current monitoring and/or maintenance activities that ensure proper functioning; discuss whether they perform an intended function; and, as appropriate, submit an AMR, including identification of credited AMPs.

(c) Describe the fill concrete, including its strength, thickness, underground profile, and construction procedures. Also define the groundwater level with respect to the fill concrete profile.

(d) Describe plant-specific operating experience concerning settlement of buildings resting on fill concrete.

(e) Discuss whether fill concrete performs an intended function; and, as appropriate, submit an AMR, including identification of credited AMPs.

In its response to RAI 3.5-6, the applicant stated the following:

> (a) Underdrain (de-watering) systems are not used at VCSNS.
>
> (b) Since underdrain (de-watering) systems are not used at VCSNS, there are no monitoring or maintenance activities or functional requirements.
>
> (c) Fill concrete (1500 psi minimum compressive strength at 28 days) was used as a leveling mat to construct the structural foundations for the Reactor, Auxiliary and Control Buildings. The fill concrete design is not porous, rather it just has a higher water-cement ratio than the higher strength structural foundation mixes of 3000 psi and greater. The fill concrete was placed directly on clean, competent bedrock, which has a design allowable bearing capacity of 200 ksf (1389 psi). The fill concrete was placed in minimum 5' lifts on an irregular rock surface, with thickness varying from approximately 5' to 50' (depending on varying elevations of rock surface and structure foundations). The levels of fill concrete range from approximately elevation 344' to 407', while the nominal groundwater elevation is at elevation 423'. [Refer to VCSNS FSAR Sections 2.5 and 3.8.]
>
> (d) There has been no operating experience at VCSNS concerning settlement of buildings resting on fill concrete. The initial design of the fill concrete determined that post-construction settlement would be practically nil, since only minimal settlement would occur from the initial construction loads.
>
> (e) The fill concrete does not perform an intended function since it was designed to be equivalent to rock as an underlying base, and is not evaluated under any aging management programs.

In its assessment of fill concrete, the staff evaluated the information provided in the LRA, the applicant's RAI responses, and the referenced FSAR sections, in order to reach a determination whether the fill concrete should be in the license renewal scope and whether aging management is required. Since the fill concrete was designed to be equivalent to rock as an underlying base and has a bearing capacity comparable to the design allowable for the bedrock, the staff concludes that, for the purpose of license renewal, the fill concrete can be considered an extension of the bedrock. Therefore, it is outside the scope of license renewal.

Also, in part (b) to RAI 3.5-9, the staff requested the applicant to clarify LRA Table 3.5-1, AMR Item 8. There is reference to three AMPs, even though the containment foundation is not subject to settlement.

In its response to RAI 3.5-9 (b), the applicant stated the following:

> As discussed in Application Table 3.5-1, Item 8, the VCSNS containment foundation is constructed directly on fill concrete over competent bedrock and is not subject to settlement; therefore, aging management is not required. [See response to RAI 3.5-6.] However, regardless if settlement is not considered as an applicable aging mechanism, existing AMPs (10 CFR 50 Appendix J General Visual Inspection, Containment ISI Program - IWE/IWL, and Maintenance Rule Structures Program) will still be used to look for concrete aging effects such as cracks and distortion.

The staff concurs that in the unlikely event of containment foundation settlement, the identified AMPs will be effective in detecting the applicable aging effects.

On the basis of its review, the staff finds that the applicant has appropriately evaluated AMR results involving management of cracking, distortion, and increase in component stress level due to settlement and reduction of foundation strength due to erosion of porous concrete subfoundations for containment components, as recommended in the GALL Report. Since the applicant's AMR results are other wise consistent with the GALL report, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

Reduction of Strength and Modulus of Concrete Structures Due to Elevated Temperature

As stated in the SRP-LR, for the containment structure, the GALL Report recommends further evaluation to manage the aging effect change in material properties as manifested by a reduction in strength and modulus, if any portion of the containment concrete exceeds the temperature limit of 150 °F. The GALL Report notes that the implementation of Subsection IWL examinations and 10 CFR 50.55a would not be able to detect the reduction of concrete strength and modulus due to elevated temperature, and also notes that no mandated aging management exists for managing this aging effect.

The GALL Report recommends that a plant-specific evaluation be performed if any portion of the concrete containment components exceeds specified temperature limits (i.e., general temperature 66 °C (150 °F) and local area temperature 93 °C (200 °F)). The staff verified that the applicant's discussion in the renewal application indicates that the affected PWR containment components are not exposed to temperatures that exceed the above temperature limits.

The applicant addressed the above criterion defined in the GALL Report, regarding the need for further evaluation, in LRA Table 3.5-1, AMR Item 10. The applicant stated the following regarding temperatures within the containment structure:

> The VCSNS containment concrete elements are not exposed to temperatures which exceed the thresholds for degradation; therefore, reduction of strength and modulus due to elevated temperatures are not aging effects requiring management.

This statement does not seem to be consistent with the information presented in Report TR00170-003, Revision 0, Table 6.1-1, and the discussion on page 59 of the report. The table indicates that there is one region (above the reactor head but below the operating floor elevation 463') that has a maximum temperature of 157 °F. Page 59 of the report also indicates that the CRDM is maintained at a temperature of less than or equal to 170 °F. The report concludes that these temperatures are localized and do not exceed 200 °F. The report follows with some additional discussion about elevated temperature concerns for three areas inside the reactor building. Some design modifications were made to rearrange air flow in the reactor building and tests were made in which the inspector identified no further problems. From the information presented, it is not clear to the staff which regions currently experience temperatures above 150 °F, whether these are area temperatures or localized temperatures around hot piping penetrations, and how aging effects due to elevated temperatures will be managed.

In RAI 3.5-12, the staff requested the following additional information:

(a) Explain the apparent inconsistency between LRA Table 3.5-1, AMR Item 10 and the information in Report TR00170-003, Revision 0 (see above discussion).

(b) For all structures in the scope of license renewal, identify all regions that currently experience temperatures in excess of 150 °F.

(c) If there are regions that currently experience temperatures in excess of 150° F, indicate whether these are area temperatures or localized temperatures around hot penetrations.

(d) If any area temperatures exceed 150 °F and/or any localized temperatures exceed 200° F, how will change in material properties of concrete due to elevated temperatures be managed during the period of extended operation?

In its response to RAI 3.5-12, the applicant stated the following:

> (a) VCSNS does not believe that there is any inconsistency between Application Table 3.5-1, Item 10, and TR00170-003, Table 6.1-1 and Section 6.4. The Application states that containment concrete elements are not exposed to temperatures, which exceed the thresholds for degradation. These thresholds are consistent with the guidance provided in GALL, which defines elevated temperatures as greater than 150 °F general and 200 °F local (GALL II.A1.1-h). Specifically: Table 6.1-1 of TR00170-003 lists a maximum temperature of 157 °F for the area above the reactor head but below operating floor elevation 463' (which is an open area above the vessel). This specific area above the head has no direct contact or support with concrete from the surrounding primary shield walls. Therefore, the general area temperature for the concrete would actually be less than 157 °F. Regardless, the reactor vessel should be considered as a large hot pipe within the penetration opening of the massive primary shield walls, which would allow a local maximum temperature of 200 °F.
>
> Section 6.4 of TR00170-003 states that the Control Rod Drive Mechanism (CRDM) is maintained at a temperature less than or equal to 170 °F. The CRDM is supported by the reactor vessel head and extends upwards in an area away from surrounding concrete of the primary shield walls. For the same reason as stated above, these temperatures are considered to be localized and do not exceed the threshold value of 200 °F.
>
> (b) Temperatures for all structures in the scope of license renewal are identified in Table 6.1-1 and Section 6.4.1 of TR00170-003. Regions exceeding 150 °F have been discussed in Response (a) above.
>
> (c) As discussed above, these areas are considered to be localized temperatures.
>
> (d) Since these temperatures fall within the industry accepted thresholds, there are no changes in material properties of concrete expected; therefore, aging management is not required.

Since the two areas inside containment that experience temperatures above the 150 °F limit (157 °F, 170 °F) are localized and not in direct contact with concrete, the staff concurs with the applicant's conclusion that further evaluation, as recommended by the GALL Report, is not required.

On the basis of its review, the staff finds that the applicant has appropriately evaluated AMR results involving management of the reduction of strength and modulus of concrete structures due to elevated temperature for containment components, as recommended in the GALL Report. Since the applicant's AMR results are other wise consistent with the GALL report, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

Loss of Material Due to Corrosion in Inaccessible Areas of Steel Containment Shell or Liner Plate

As stated in the SRP-LR, the GALL Report recommends further evaluation to manage the aging effect of loss of material due to corrosion for the embedded containment liner, if corrosion of the embedded liner is significant. The AMP recommended by the GALL Report for managing loss of material for accessible steel elements within the containment structure is the ASME Section XI, Subsection IWE (XI.S1) Program. The staff's evaluation of the applicant's ASME Section XI, Subsection IWE AMP is in Section 3.5.2.3.6 of this SER.

Subsection IWE exempts from examination portions of the containments that are inaccessible, such as embedded or inaccessible portions of steel liners and steel containment shells, piping, and valves penetrating or attaching to the containment. To cover inaccessible areas, 10 CFR 50.55a(b)(2)(ix) requires that the licensee evaluate the acceptability of inaccessible areas when conditions exist in accessible areas that could indicate the presence of, or result in, degradation to inaccessible areas.

The applicant addressed the above criterion defined in the GALL Report, regarding the need for further evaluation to manage the potential aging of the embedded containment liner, in LRA Table 3.5-1, AMR Item 12. Regarding the potential for significant corrosion of the embedded steel containment liner, the applicant stated the following:

> Corrosion for inaccessible areas (embedded containment liner) is not significant because:
>
> > Concrete meeting the requirements of ACI 318 or 349 and the guidance of 201.2R was used for the containment concrete in contact with the embedded containment liner.
> >
> > The concrete is monitored under Maintenance Rule Structures Program and IWL to ensure that it is free of penetrating cracks.
> >
> > The moisture barrier is monitored under IWE for aging degradation.
> >
> > Borated water leakage in the containment structure is not a common occurrence and is monitored under the aging management program Boric Acid Corrosion Surveillances (App. B.1.2).

The staff noted that the plant-specific operating experience does not necessarily support this conclusion. LRA Appendix B.1.12.1 indicates that rust was identified on the reactor building liner plate adjacent to the moisture barrier and the moisture barrier had degraded. Therefore, it is not evident that loss of material due to corrosion in inaccessible areas of the containment liner is not significant at VCSNS. It is also unclear to the staff why the nonconformance discussed in LRA Appendix B.1.12.1 was identified by the Appendix J Leak Rate Testing program (B.1.12), and not by the Appendix J General Visual Inspection Program (B.1.11) and/or the Containment ISI Program—IWE/IWL (B.1.16).

In RAI 3.5-13, the staff requested the following additional information:

(a) What inspections have been conducted to assess the condition of the liner embedded in the concrete base?

(b) Confirm that the nonconformance discussed in LRA Appendix B.1.12.1 was detected prior to the implementation of the B.1.16 AMP. If not, explain why this nonconformance was not detected under the B.1.16 aging management program.

(c) Explain why this nonconformance was not detected under the B.1.11 AMP.

(d) Clarify the scope of and interaction between all three AMPs (B.1.11, B.1.12, and B.1.16).

(e) The rust on the liner plate and the degraded moisture barrier could indicate the presence of or result in degradation in the inaccessible areas of the containment liner. Discuss how the acceptability of the inaccessible areas of the containment liner was evaluated as a result of this nonconformance.

(f) Since this type of degradation has already occurred, what is the technical basis for concluding that it could not occur again?

(g) Clarify whether the supplemental requirements of 10 CFR 50.55a for inaccessible areas are credited for license renewal aging management of the inaccessible liner plate.

In its response to RAI 3.5-13, the applicant stated the following:

> (a) Application Section B.1.12.1 states: "A non-conformance (NCN) was documented for rust found on the Reactor Building liner plate adjacent to the moisture barrier and for a degraded moisture barrier. The disposition was to clean up the rust on the Reactor Building liner plate adjacent to the moisture barrier and to replace affected portions of the moisture barrier. Visual examination and ultrasonic tests demonstrated that the liner plate had not degraded. The evaluation concluded that the condition was normal surface life exposure and was not aging related." ---A more in-depth inspection of the liner was not warranted as a result of this NCN, since the liner was found to have an insignificant reduction in thickness in the areas of observed rusting. [Note that additional inspections of inaccessible areas would have been warranted if any significant liner degradation had been found in these accessible areas.] Future inspections of the moisture barrier and adjacent liner will be conducted under the Containment ISI Program - IWE/IWL (B.1.16).
>
> (b) The observed liner rusting and degradation of the moisture barrier was identified in 1999 during outage walkdowns by engineering and QC personnel. Such walkdowns have been conducted for many years and preceded the implementation of the Containment ISI Program - IWE/IWL. Inspection of the moisture barrier is now part of the Containment ISI Program - IWE/IWL. The NCN is discussed in Application Section B.1.12 (Appendix J Leak Rate Testing Program) since the other major containment inspection programs were not conducted during that particular outage.
>
> (c) This NCN was identified during normal outage walkdowns and not detected under the 10 CFR 50 Appendix J General Visual Inspections (B.1.11) since they were not required during the 1999 outage. The last prior General Visual Inspection was conducted in 1997. [See Response d) below.]
>
> (d) The 10 CFR 50 Appendix J General Visual Inspection (B.1.11) is conducted two times in the 10 year period preceding the Type A ILRT. The 10 CFR 50 Appendix J Leak Rate Tests (B.1.12) (Type A, B, C) are conducted in accordance with established frequencies per regulation. The Containment ISI Program - IWE/IWL (B.1.16) was initiated in 2000 and will be conducted on a 5-year frequency.
>
> (e) No further inspections of the liner were warranted as a result of this NCN, since the liner was found to have an insignificant reduction in thickness in the areas of observed rusting. UT examinations were conducted at various locations around containment in areas where rusting was observed, along with a control area not showing rust. The moisture barrier was removed in these areas, the rust/paint was mechanically cleaned, and UT examinations were made at floor level and several inches into the annulus gap. The UT examinations showed no significant loss of liner thickness when compared to the design thickness, with results well within the ± 10% fabrication tolerance of the liner. Consistent with the current provisions of ASME Section XI -

> IWE/IWL, additional inspections of inaccessible areas would have been warranted if any significant liner degradation had been found in these accessible areas.
>
> (f) The moisture barrier is an elastomer, which is subject to degradation (splitting, separation, etc.) over time; therefore, this type of degradation could occur again. The current AMPs (Containment ISI Program - IWE/IWL and Maintenance Rule Structures Program) have proven effective in managing the condition of the moisture barrier in order to preclude any significant degradation of the liner.
>
> (g) The supplemental requirements of 10 CFR 50.55a for inaccessible areas are credited for license renewal aging management of the inaccessible liner plate. [Note that additional inspections of inaccessible areas will be warranted if any significant liner degradation is found in adjacent accessible areas during future inspections.]

Since the applicant's inspection did not find significant corrosion in the inaccessible portion of the containment liner plate, and since the applicant credits its ASME Section XI, Subsection IWE AMP for managing loss of material for the accessible portion of the containment liner plate, the staff finds the applicant's response to RAI 3.5.1-13, to be acceptable. As required by 10 CFR 50.55a(b)(2)(ix), the applicant will inspect the inaccessible portions of the containment liner plates, if significant corrosion of the accessible portions of the liner plate is observed.

On the basis of its review, the staff finds that the applicant has appropriately evaluated AMR results involving management of loss of material due to corrosion in inaccessible areas of steel containment shell or liner plate for containment components, as recommended in the GALL Report. Since the applicant's AMR results are other wise consistent with the GALL report, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

<u>Loss of Prestress Due to Relaxation, Shrinkage, Creep, and Elevated Temperature</u>

As stated in the SRP-LR, the GALL Report identifies loss of prestress due to relaxation, shrinkage, creep, and elevated temperature for prestressed containment tendons and anchorage components as a TLAA to be performed for the period of extended operation.

The applicant addressed loss of prestress due to relaxation, shrinkage, creep, and elevated temperature for prestressed containment tendons and anchorage components in LRA Table 3.5-1, AMR Item 11. The applicant stated the following:

> VCSNS aging management programs Containment ISI Program - IWE/IWL (App. B.1.16) and Tendon Surveillance Program (App. B.3.3) are consistent with those reviewed and approved in NUREG-1801.
>
> VCSNS Containment tendons have been determined to be a TLAA in accordance with 10 CFR 54.3. Refer to Section 4.5.

The staff notes that the applicant's Tendon Surveillance Program (B.3.3) is consistent with GALL X.S1, for implementing TLAA option (iii) of 10 CFR54.21(c)(1). The staff's evaluation of this AMP is in Section 3.5.2.3.12 of this SER. The staff's evaluation of this TLAA is in Section 4.5 of this SER.

<u>Cumulative Fatigue Damage</u>

As stated in the SRP-LR, the GALL Report identifies cumulative fatigue damage of penetration sleeves, penetration bellows, and dissimilar metal welds as a TLAA, if a CLB fatigue analysis exists. If applicable, the TLAA must be updated to include the period of extended operation. The applicant addressed this TLAA in LRA Table 3.5-1, AMR Item 1. The applicant stated the following:

> VCSNS does not evaluate fatigue for penetration sleeves, bellows or dissimilar metal welds; therefore, a TLAA evaluation is not applicable.
>
> Penetration sleeves meet the requirements of ASME section III, comply with GDC-51, and behave in a non-brittle manner.
>
> Penetration bellows are used in hot penetrations at VCSNS but do not provide containment isolation since they are located within the penetration on the exterior side of containment, Hot penetrations are sealed on the inside of containment by a flat plate welded to both the penetration sleeve and process pipe (similar to cold penetrations), thus providing containment isolation without the use of a resilient seal.
>
> Dissimilar metal welds are materials and not components. VCSNS penetration sleeves and process pipes use similar (SA) materials.

Since containment isolation is accomplished by the flat plate closures, in RAI 3.5-9, part (a), the staff requested the applicant to submit the following additional information about the design basis for these closures:

Describe how the design basis for the flat plate containment penetration closures considered cyclic loading due to temperature/pressure transients. If a CLB fatigue analysis exists for the flat plate penetration closures, has it been updated for a 60-year operating life? How will cracking due to cyclic loading be managed for the period of extended operation?

In its response to RAI 3.5-9, part (a), the applicant stated the following:

> (a) For containment penetration closures, the flat plate is basically no more than an extension of the containment liner plate which connects to the penetration sleeve. The containment liner plate was reviewed for fatigue analysis as originally calculated for 40 years. The calculation was subsequently revised to show that fatigue analysis was acceptable for 60 years. Application Section 4.6.1 discusses the TLAA review for the containment liner for which VCSNS utilized 10 CFR 54.21(c) (1) Option (ii) to demonstrate that liner fatigue is adequately analyzed for the period of extended operation.

The applicant refers to the LRA Section 4.6.1 evaluation of the containment liner plate TLAA, implying that it is also applicable to the flat plate closures. The staff's evaluation of the TLAA for the containment liner plate is in Section 4.6 of this SER. The acceptability of this TLAA for the flat plate containment penetration closures was confirmed and discussed in Section 4.6 of this SER.

<u>Cracking due to Cyclic Loading and Stress-Corrosion Cracking</u>

As stated in the SRP-LR, the GALL Report recommends further evaluation of the AMPs credited to manage cracking of containment penetrations (including penetration sleeves, penetration bellows, and dissimilar metal welds) due to cyclic loading or SCC for all types of PWR containments. Containment ISI and leak rate testing may not be sufficient to detect cracks induced by cyclic loading or SCC. The staff evaluated the applicant's proposed

programs to verify that adequate inspection methods will be implemented to ensure that cracking of containment penetrations is detected.

The applicant addressed cracking of containment penetrations in LRA Table 3.5-1, AMR Item 2. Consistent with GALL, the applicant credits containment ISI and leak rate testing for managing this aging effect. However, augmented inspection to detect cracks is not identified. The applicant stated the following:

> Stress Corrosion Cracking (SCC) requires a combination of a corrosive environment, susceptible materials, and high tensile stresses,
>
> (1) VCSNS penetration sleeves are not subject to high tensile stresses or aggressive chemicals during normal operation, while similar metal welds are used between penetration sleeves and process pipes; therefore, SCC is not an applicable aging effect requiring management.
>
> (2) VCSNS hot penetration bellows do not perform a pressure boundary function nor incorporate a flexible seal assembly on the inboard side of containment. They do provide structural and/or functional support for process piping on the outboard side of containment; therefore, in the unlikely event of SCC in the bellows, the intended functions are not affected.

The staff noted that although the containment pressure boundary may not be affected, failure of the bellows would appear to affect other intended functions. In addition, AMR Item 2 credits the Appendix J General Visual Inspection Program, Appendix J Leak Rate Testing Program, and Containment ISI Program—IWE-IWL as AMPs. These programs would appear to be applicable only to the welded flat plate closures that are part of the containment pressure boundary, and not to the penetration bellows.

In RAI 3.5-16, the staff requested the following information:

(a) Explain why cracking of the stainless steel penetration bellows (and the associated dissimilar metal welds) does not affect the bellows' intended function to "provide structural and/or functional support for process piping on the outboard side of containment."

(b) Identify the aging effects that are applicable to the penetration bellows (and the associated dissimilar metal welds), and the AMPs that are credited to manage aging.

In its response to RAI 3.5-16, the applicant stated the following:

> (a) Bellows on hot piping penetrations do not perform a pressure boundary function, but they do provide structural and/or functional support (i.e., thermal and accident movement of the process pipe). In the unlikely event that cracking of the stainless steel penetration bellows occurs, thermal and accident movement of the process pipe would not be impaired and therefore will not diminish the bellows' intended function. Loss of Material and Cracking aging effects for penetration bellows have been screened out due to the plant specific design and bellow protection features. Refer to Sections 6.2, 6.9, and 8.3 of TR00170-003 under Bellows.
>
> (b) Stainless steel bellows are very compliant (flexible), therefore sustained high tensile stress does not exist. However, cracking of the bellows due to SCC would not impair the intended function. All containment penetrations are inspected (both inside and outside containment) as part of the Containment ISI Program - IWE/IWL.

The staff finds the applicant's response to RAI 3.5.1-16, to be acceptable, and concurs that the function of the stainless steel bellows to allow free axial movement of the process piping is not affected by cracking. Therefore, the staff concludes that cracking due to cyclic loading or SCC

is not an applicable aging effect for VCSNS and augmented inspection to detect cracking is not necessary.

On the basis of its review, the staff finds that the applicant has appropriately evaluated AMR results involving management of cracking due to cyclic loading and SCC for containment components, as recommended in the GALL Report. Since the applicant's AMR results are other wise consistent with the GALL report, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

Conclusion

The staff has reviewed the applicant's evaluation of the issues related to structural components in containment for which the GALL Report recommends further evaluation. On the basis of its review, the staff finds that the applicant has provided sufficient information to demonstrate that the issues for which the GALL Report recommends further evaluation have been adequately addressed, and that the subject aging effects will be adequately managed for the period of extended operation.

3.5.2.2.2 Class I Structures

Aging of Structures Not Covered by Structures Monitoring Program

As stated in the SRP-LR, the GALL Report recommends further evaluation for certain structure/aging effect combinations, if they are not covered by the applicant's Structures Monitoring Program. This includes (1) scaling, cracking, and spalling, due to repeated freeze-thaw for Groups 1-3, 5, 7-9 structures; (2) scaling, cracking, spalling and increase in porosity and permeability due to leaching of calcium hydroxide and aggressive chemical attack for Groups 1-5, 7-9 structures; (3) expansion and cracking due to reaction with aggregates for Groups 1-5, 7-9 structures; (4) cracking, spalling, loss of bond, and loss of material due to corrosion of embedded steel for Groups 1-5, 7-9 structures; (5) cracks, distortion, and increase in component stress level due to settlement for Groups 1-3, 5, 7-9 structures; (6) reduction of foundation strength due to erosion of porous concrete subfoundation for Groups 1-3, 5-9 structures; (7) loss of material due to corrosion of structural steel components for Groups 1-5, 7-8 structures; (8) loss of strength and modulus of concrete structures due to elevated temperatures for Groups 1-5 structures; and (9) crack initiation and growth due to SCC and loss of material due to crevice corrosion of stainless steel liner for Groups 7 and 8 structures. Further evaluation is necessary only for structure/aging effect combinations that are not covered by the applicant's Structures Monitoring Program.

In LRA Table 3.5-1, AMR item 16, the applicant credited its Maintenance Rule Structures Program, Containment Coating Monitoring and Maintenance Program, and Containment ISI Program—IWE/IWL for general aging management of accessible areas of Class I structures. However, the applicant also provided detailed technical justifications why concrete aging effects are not significant for accessible areas, and why VCSNS does not require a plant-specific program to manage aging of concrete in inaccessible areas.

The staff requested additional information in RAIs 3.5-2, 3.5-9, part (e), and 3.5-11 related to clarification of the applicant's commitment to manage aging of accessible and inaccessible concrete components of Class I structures. Based on the applicant's responses to these RAIs, the staff concludes that accessible and inaccessible concrete components of Class I structures will be adequately managed, in accordance with the GALL Report. The staff's detailed evaluation of this issue is in Section 3.5.2.4 of this SER.

On the basis of its review, the staff finds that the applicant has appropriately evaluated AMR results involving management of aging of structures not covered by Structures Monitoring Program for Class I structures, as recommended in the GALL Report. Since the applicant's AMR results are other wise consistent with the GALL report, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

Aging Management of Inaccessible Areas

As stated in the SRP-LR, the GALL Report recommends further evaluation for aging of inaccessible concrete areas, such as below-grade foundation and exterior walls exposed to groundwater due to aggressive chemical attack, if an aggressive below-grade environment exists. An aggressive below-grade environment could result in either cracking or loss of material for concrete components subjected to such an environment. The GALL Report recommends that a plant-specific AMP be developed by the applicant, if an aggressive below-grade environment exists.

The staff's evaluation and resolution of this issue for containment also applies to Class I structures, and is documented in Section 3.5.2.2.1 - Aging of Inaccessible Concrete Areas, of this SER.

Conclusion

The staff has reviewed the applicant's evaluation of the issues related to structural components in Class I structures for which the GALL Report recommends further evaluation. On the basis of its review, the staff finds that the applicant has provided sufficient information to demonstrate that the issues for which the GALL Report recommends further evaluation have been adequately addressed, and that the subject aging effects will be adequately managed for the period of extended operation.

3.5.2.2.3 Component Supports

Aging of Supports Not Covered by Structures Monitoring Program

As stated in the SRP-LR, the GALL report recommends further evaluation of certain component support/aging effect combinations if they are not covered by the SRP. This includes (1) reduction in concrete anchor capacity due to degradation of the surrounding concrete, for Groups B1-B5 supports; (2) loss of material due to environmental corrosion, for Groups B2-B5 supports; and (3) reduction/loss of isolation function due to degradation of vibration isolation elements, for Group B4 supports. Further evaluation is necessary only for the structure/aging

effect combinations, listed above, that are not covered by the applicant's Structures Monitoring Program.

In LRA Table 3.5-1, AMR item 25, the applicant credited its Maintenance Rule Structures Program and its 10 CFR Part 50 Appendix J General Visual Inspection Program to manage aging of component supports. The applicant also included a technical basis for concluding that "cracking due to fatigue is not an aging effect requiring management for concrete components." This is consistent with the staff position. In RAI 3.5-9, part (f), the staff requested the applicant to clarify which supports/aging effects are managed by each of the two credited programs.

In its response to RAI 3.5-9, part (f), the applicant stated the following:

> (f) For Application Table 3.5-1, Item 25, the Maintenance Rule Structures Program applies to all subcomponents for all structures (including containment), while the 10 CFR 50 Appendix J General Visual Inspection is used only as a supplementary inspection program for containment. As noted in the discussion for Item 25, cracking due to fatigue is not an aging effect requiring management for concrete components.

Since the applicant credited its Maintenance Rule Structures Program, as recommended by the GALL Report, the staff finds that the applicant has adequately addressed this further evaluation criterion.

On the basis of its review, the staff finds that the applicant has appropriately evaluated AMR results involving management of aging of component supports, as recommended in the GALL report. Since the applicant's AMR results are other wise consistent with the GALL report, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

Cumulative Fatigue Damage Due to Cyclic Loading

As stated in the SRP-LR, the GALL Report identifies cumulative fatigue damage as a TLAA for support members, anchor bolts, and welds for Groups B1.1, B1.2, and B1.3 component supports, if a CLB fatigue analysis exists. In LRA Table 3.5-1, AMR Item 26, the applicant stated that TLAA is not applicable since CLB fatigue analyses do not exist for these component types at VCSNS. The staff finds this acceptable, on the basis that CLB fatigue analyses do not exist.

Conclusion

The staff has reviewed the applicant's evaluation of the issues related to structural components in component supports for which the GALL Report recommends further evaluation. On the basis of its review, the staff finds that the applicant has provided sufficient information to demonstrate that the issues for which the GALL Report recommends further evaluation have been adequately addressed, and that the subject aging effects will be adequately managed for the period of extended operation.

3.5.2.3 Aging Management Programs for Containment, Structures, and Component Supports

The applicant credits 16 AMPs to manage the aging effects associated with structures and structural components. The location in this SER of the staff's evaluation of each AMP is listed below. The location of the description of each AMP in Appendix B of the LRA is shown in parenthesis.

- Boric Acid Corrosion Surveillances Program (B.1.2)(Section 3.0.3.1)
- Chemistry Program (B.1.4)(Section 3.0.3.2)
- Fire Protection Program (B.1.5)(Section 3.0.3.3)
- 10 CFR 50 Appendix J General Visual Inspection Program (B.1.11)(Section 3.5.2.3.1)
- 10 CFR 50 Appendix J Leak Rate Testing Program (B.1.12)(Section 3.5.2.3.2)
- ASME Section XI ISI Program - IWF (B.1.13)(Section 3.5.2.3.3)
- Battery Rack Inspection Program (B.1.14)(Section 3.5.2.3.4)
- Containment Coating Monitoring and Maintenance Program (B.1.15)(Section 3.5.2.3.5)
- Containment ISI Program—IWE/IWL (B.1.16)(Section 3.5.2.3.6)
- Flood Barrier Inspection Program (B.1.17)(Section 3.5.2.3.7)
- Maintenance Rule Structures Program (B.1.18)(Section 3.0.3.4)
- Pressure Door Inspection Program (B.1.20)(Section 3.5.2.3.8)
- Service Water Pond Dam Inspection Program (B.1.21)(Section 3.5.2.3.9)
- Service Water Structures Survey Monitoring Program (B.1.22)(Section 3.5.2.3.10)
- Underwater Inspection Program (SWIS and SWPH) (B.1.23)(Section 3.5.2.3.11)
- Tendon Surveillance Program (B.3.3)(Section 3.5.2.3.12)

The staff reviewed the applicant's AMP descriptions to compare those AMPs for which the applicant claimed consistency with those reviewed and approved in the GALL report. For those AMPs that are not evaluated in GALL, the staff evaluated the AMP against the 10 program elements (BTP RLSB-1 in Section A-1 of NUREG-1800 Appendix A). The staff also conducted an audit of all credited AMPs on July 16–17, 2003, at VCSNS.

Several VCSNS AMPs were described by the applicant as being consistent with GALL, but with some deviation from GALL. These deviations are of two types— clarifications to GALL or enhancements to GALL. In Appendix B of the LRA, the applicant states that a clarification is provided for instances where the VCSNS program does not match specific details of a NUREG-1801 program element but is still determined to be consistent. For each AMP that had one or more of these deviations, the staff reviewed each deviation to determine (1) whether the deviation is acceptable and (2) whether the AMP, as modified, would adequately manage the aging effect(s) for which it is credited.

The staff also reviewed the FSAR supplements for the AMPs credited with managing aging in structures and structural components to determine whether the program description adequately describes the program. The staff's evaluation of the FSAR supplement for each AMP is included in the SER for each AMP.

3.5.2.3.1 10 CFR Part 50 Appendix J General Visual Inspection Program

<u>Summary of Technical Information in the Application</u>

In LRA Section B.1.11, the applicant stated that the 10 CFR Part 50 Appendix J General Visual Inspection Program is consistent with XI.S4, 10 CFR 50 Appendix J, as identified in NUREG-1801.

The 10 CFR Part 50 Appendix J General Visual Inspection Program is included in the discussion column of LRA Table 3.5-1 for a number of containment components and component supports, but is not credited to manage aging effects for license renewal in Report TR00170-003, Revision 0, Attachment II: Aging Management Review for Structures and Structural Components.

No licensee event reports (LERs) were initiated subsequent to any general visual structural examination of the containment system. There were no NCNs or CERs identified that resulted from conditions related to aging mechanisms.

The applicant concluded that the 10 CFR Part 50 Appendix J General Visual Inspection Program provides reasonable assurance that the aging effects for the containment liner, associated moisture barriers, and the reactor building structure will be managed such that the components subject to AMR will continue to perform their intended functions consistent with the CLB for the period of extended operations.

Staff Evaluation

The applicant stated that 10 CFR Part 50 Appendix J General Visual Inspection Program is consistent with XI.S4, 10 CFR Part 50 Appendix J, as identified in NUREG-1801. However, the scope of GALL XI.S4 is for containment leak rate testing and not general visual inspection of containments. Inspection of containments is covered by GALL XI.S1 and XI.S2, which involve ASME Section XI, Subsections IWE and IWL, respectively. The applicant stated in LRA Section B.1.16 that the Containment ISI Program—IWE/IWL is consistent with GALL XI.S1 and XI.S2. The 10 CFR Part 50 Appendix J General Visual Inspection Program is included in the discussion column of LRA Table 3.5-1, but is not identified as a credited AMP in Report TR00170-003, Revision 0, Attachment II: Aging Management Review for Structures and Structural Components.

In RAI 3.5-20, the applicant was requested to provide additional information as to whether the 10 CFR Part 50 Appendix J General Visual Inspection Program is credited as an AMP for license renewal. In response to RAI 3.5-20, the applicant stated the following:

> (a) The 10 CFR 50 Appendix J General Visual Inspection is only one component of the total Appendix J Program. Under Appendix J, a visual examination of accessible interior and exterior surfaces of the containment system shall be conducted during two other refueling outages before the next Type A test if the interval for the Type A test has been extended to 10 years, in order to allow for early uncovering of evidence of structural deterioration. These inspections are conducted by Operations personnel and provide additional inspections for aging management of the containment, thus being credited for license renewal. This program is only used as a supplement, not substitute, for the Containment ISI Program - IWE/IWL.
>
> (b) There are no elements of containment inspection (IWE/IWL) which rely solely on the 10 CFR 50 Appendix J General Visual Inspection.
>
> (c) The AMPs listed in Attachment II (Reactor Building) of TR00170-003 are the primary programs used to manage aging. The 10 CFR 50 Appendix J General Visual Inspection is only used as supplemental information and does not substitute for any of the programs identified.

On the basis that this program is supplementary to the Containment ISI Program—IWE/IWL (B.1.16) and 10 CFR Part 50 Appendix J Leak Rate Testing Program (B.1.12), and is not

credited as a substitute for any of the requirements of these two programs, the staff accepts this program without further evaluation see SER Sections 3.5.2.3.2 and 3.5.2.3.6 for the staff evaluation of the Appendix J Leak Rate Testing and IWE/IWL Programs, respectively).

Conclusions

On the basis of its review and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.5.2.3.2 10 CFR Part 50 Appendix J Leak Rate Testing Program

Summary of Technical Information in the Application

In LRA Section B.1.12, the applicant stated that the 10 CFR Part 50 Appendix J Leak Rate Testing Program is consistent with XI.S4, 10 CFR Part 50 Appendix J, as identified in NUREG-1801.

The 10 CFR 50 Appendix J Leak Rate Testing Program (B.1.12) is included in the discussion column of LRA Table 3.5-1 and credited to manage aging effects for license renewal in Report TR00170-003, Revision 0, Attachment II: Aging Management Review for Structures and Structural Components for the following reactor building components:

- compressible joints and seals
- liner plate
- penetrations (mechanical and electrical)
- personnel airlock, escape airlock, and equipment hatch

This program is also credited to manage aging effects for license renewal for the liner plate (RHR and spray system isolation valve chambers and guard pipes) in the auxiliary building.

Over three refueling cycles (most recently RF-10, RF-11, and RF-12), Type B penetrations delineated in the station surveillance procedure were tested with satisfactory results. A nonconformance was documented for rust found on the reactor building liner plate adjacent to the moisture barrier and a degraded moisture barrier. The disposition was to cleanup the rust on the reactor building liner plate adjacent to the moisture barrier and to replace affected portions of the moisture barrier. Visual examination and ultrasonic tests demonstrated that the liner plate had not degraded. The evaluation concluded that the condition was normal surface life exposure and was not aging related.

The applicant concluded that the 10 CFR Part 50 Appendix J Leak Rate Testing Program provides reasonable assurance that the aging effects for the components forming the containment pressure boundary will be managed such that the components subject to AMR will

continue to perform their intended functions consistent with the CLB for the period of extended operations.

Staff Evaluation

In LRA Section B.1.12, “10 CFR 50 Appendix J Leak Rate Testing” the applicant described its AMP to manage aging for the components forming the containment pressure boundary. The LRA stated that this AMP is consistent with GALL AMP XI.S4, “10 CFR 50 Appendix J” with no deviations. The staff audit on July 16–17, 2003 confirmed the applicant’s claim of consistency. The staff also reviewed the FSAR supplement to determine whether it provides an adequate description of the program.

The staff noted several inconsistencies between the FSAR supplement summary descriptions of the AMPs in LRA Appendix A and the scope of the AMPs identified in LRA Appendix B as “consistent with GALL.” In RAI 3.5-19, the staff requested the applicant to verify that the complete scope of the aging management program, as described in NUREG-1801, GALL Volume 2, is being credited to manage aging effects for license renewal. If this is not the case, the applicant was requested to identify and document the justification for each exception. In response to RAI 3.5-19, the applicant stated the following:

> As stated in the Application, VCSNS maintains a 10 CFR 50 Appendix J Leak Rate Testing Program (B.1.12) using Option B, which is consistent with GALL XI.S4 and RG 1.163.
>
> VCSNS does not believe that there are any further changes required for the Application Appendix A, since only summary statements are recommended by NEI 95-10. Commitment to all Regulations and Regulatory Guides are implicit in the development of each of these programs as described in Section 7 of TR00170-003.

In LRA Section B.1.12.1 on operating experience, the applicant discussed a nonconformance that was documented for rust found on the reactor building liner plate adjacent to the moisture barrier and a degraded moisture barrier. The disposition was to cleanup the rust on the reactor building liner plate adjacent to the moisture barrier and to replace affected portions of the moisture barrier. Visual examination and ultrasonic tests demonstrated that the liner plate had not degraded. The evaluation concluded that the condition was normal surface life exposure and was not aging related.

In RAI 3.5-13 parts (b), (c), and (d), the staff requested the applicant to provide additional information as to why the nonconformance discussed in LRA Appendix B.1.12.1 was identified by the Appendix J Leak Rate Testing Program (B.1.12), and not by the Appendix J General Visual Inspection program (B.1.11) and/or the Containment ISI Program—IWE/IWL (B.1.16).

In response to RAI 3.5-13 parts (b), (c) and (d), the applicant stated the following:

> (a) The observed liner rusting and degradation of the moisture barrier was identified in 1999 during outage walkdowns by engineering and QC personnel. Such walkdowns have been conducted for many years and preceded the implementation of the Containment ISI Program - IWE/IWL. Inspection of the moisture barrier is now part of the Containment ISI Program - IWE/IWL. The NCN is discussed in Application Section B.1.12 (Appendix J Leak Rate Testing Program) since the other major containment inspection programs were not conducted during that particular outage.

(b) This NCN was identified during normal outage walkdowns and not detected under the 10 CFR 50 Appendix J General Visual Inspections (B.1.11) since they were not required during the 1999 outage. The last prior General Visual Inspection was conducted in 1997. [See Response d) below.]

(c) The 10 CFR 50 Appendix J General Visual Inspection (B.1.11) is conducted two times in the 10 year period preceding the Type A ILRT. The 10 CFR 50 Appendix J Leak Rate Tests (B.1.12) (Type A, B, C) are conducted in accordance with established frequencies per regulation. The Containment ISI Program - IWE/IWL (B.1.16) was initiated in 2000 and will be conducted on a 5-year frequency.

The staff finds the applicant's response to RAI 3.5-13 parts (b), (c), and (d) to be acceptable. The applicant has adequately described the relationship between the three AMPs (B.1.11, B.1.12, and B.1.16) and clearly explained why the above nonconformance was detected under the Appendix J Leak Rate Testing program.

Conclusions

On the basis of its review and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.5.2.3.3 ASME Section XI ISI Program — IWF (B.1.13)

Summary of Technical Information in the Application

In LRA Section B.1.13, the applicant stated that the ASME Section XI ISI Program — IWF is consistent with XI.S3, ASME Section XI, Subsection IWF, as identified in NUREG-1801 with the following clarification:

- VCSNS uses 1989 Edition of ASME Section XI with no Addenda

The ASME Section XI ISI Program — IWF (B.1.13) is included in the discussion column of LRA Table 3.5-1 and credited to manage aging effects for license renewal in Report TR00170-003, Revision 0, Attachment II: Aging Management Review for Structures and Structural Components for the following components in the auxiliary, reactor and intermediate buildings:

- anchorage/embedments
- equipment component supports
- expansion anchors
- pipe supports

The program is also credited to manage aging effects for license renewal for pipe supports in the control, diesel generator, fuel handling buildings and the service water pumphouse. In addition, the program is also credited for expansion anchors in the fuel handling building.

A review of ASME Class 1, 2, and 3 component support inspections for the past five years identified one case where acceptance criteria was not met. The gap at the top of a pipe support exceeded the acceptance criteria; however, this is not aging related. Two NCNs were identified for instances of minor surface corrosion on supports and anchor bolting. The intended functions were not affected and corrective actions were performed in accordance with site procedures. No CERs were initiated subsequent to ASME Class 1, 2, and 3 component support inspections.

The applicant concluded that the ASME Section XI ISI Program — IWF for Class 1, 2, and 3 component supports, and support anchorage, provides reasonable assurance that the aging effects will be managed such that the components subject to AMR will continue to perform their intended functions consistent with the CLB for the period of extended operations.

Staff Evaluation

In LRA Section B.1.13, “ASME Section XI ISI Program — IWF,” the applicant described its AMP to manage aging in ASME code supports. The LRA stated that this AMP is consistent with GALL AMP XI.S3, “ASME Section XI, Subsection IWF” with the following clarification — VCSNS uses the 1989 edition of ASME Section XI with no Addenda. The staff reviewed the clarification to determine whether the AMP, with the clarification, is adequate to manage the aging effects for which it is credited, and also reviewed the FSAR supplement to determine whether it provides an adequate description of the revised program. The staff audit on July 16–17, 2003, confirmed the applicant’s claim of consistency.

The Introduction to Appendix B, Aging Management Programs and Activities, of the LRA states that “clarification is provided for instances where the VCSNS program does not match specific details of a NUREG-1801 program element but is still determined to be consistent.” For this AMP, a clarification is provided; however, it was not clear how the VCSNS program does not match the referenced GALL AMP. In RAI 3.5-18, the staff requested the applicant to explain what is intended by the above stated clarification to the program and confirm that the program is completely consistent with GALL.

In response to RAI 3.5-18, the applicant stated the following:

> ASME Section XI ISI Program - IWF (Application B.1.13) --- The clarification is no more than a statement that VCSNS uses the 1989 Edition of ASME Section XI Code with no Addenda. This is consistent with GALL XI.S3 which states that the evaluations cover the 1989 Edition through the 1995 edition with addenda through the 1996 Addenda, as approved in 10 CFR 50.55a. VCSNS has not attempted to reconcile code differences nor requested approval for later editions.

The staff finds the applicant’s response to RAI 3.5-18, to be acceptable. The use of the 1989 Edition of the ASME Section XI Code with no Addenda is acceptable to the staff and consistent with GALL XI.S3, “ASME Section XI, Subsection IWF.”

The staff noted several inconsistencies between the FSAR supplement summary descriptions of the AMPs in LRA Appendix A and the scope of the AMPs identified in LRA Appendix B as “consistent with GALL.” Some examples of these inconsistencies are as follows.

(a) Section 18.2.5 of LRA Appendix A states that the ASME Section XI ISI Program — IWF manages "loss of material," while the parameters monitored under GALL XI.S3 are much broader and include — corrosion, deformation, misalignment, improper clearances, improper spring settings, damage to close tolerance machined or sliding surfaces, and missing, detached, or loosened support items.

(b) Section 18.2.5 of LRA Appendix A states that the ASME Section XI ISI Program — IWF manages cracking of high strength anchorage of ASME Class 1 component supports. Under GALL XI.S3, the visual inspection would be expected to identify relatively large cracks. If cracking of high strength anchorage needs to be managed, the staff would expect that the applicant would credit a program consistent with GALL XI.M18, Bolting Integrity.

In RAI 3.5-19, the staff requested the applicant to verify that the complete scope of the AMP, as described in NUREG-1801, GALL Volume 2, is being credited to manage aging effects for license renewal. If this is not the case, the applicant was requested to identify and document the justification for each exception. In response to RAI 3.5-19, the applicant stated the following:

> As stated in the Application, VCSNS maintains an ASME Section XI ISI Program - IWF (B.1.13), which is consistent with GALL XI.S3 and 10 CFR 50.55a. This RAI concludes that Application Section 18.2.5 is inconsistent by only monitoring loss of material and cracking. However, Section 18.2.5 represents only a very general overview (summary) of program content, which is consistent with the guidelines of NEI 95-10. VCSNS maintains an extensive IWF program in accordance with ASME Section XI, which evaluates all of the identified aging effects, plus others not cited.
>
> VCSNS does not believe that there are any further changes required for the Application Appendix A, since only summary statements are recommended by NEI 95-10. Commitment to all Regulations and Regulatory Guides are implicit in the development of each of these programs as described in Section 7 of TR00170-003.

In LRA Section B.1.13.1, the applicant acknowledged that improperly heat-treated anchor bolts are susceptible to SCC, based on industry operating experience, but states that ASTM A490 anchor bolt material used at VCSNS is properly heat-treated by conforming to ASTM Specification A490 through a Certified Material Test Report, in accordance with station specifications. In Report TR00170-003, Revision 0, Section 6.8.6, the applicant indicated that SCC is unlikely at VCSNS for the reasons identified therein, but further states, "Regardless, the examination requirements of ASME Section XI ISI Program - IWF manage loss of function and cracking due to SCC for the Class 1 component supports that are exposed to the Reactor Building environment." However, IWF visual inspection would be expected to identify only relatively large cracks, as noted in GALL XI.S3. If cracking of high-strength anchorage needs to be managed, the staff would expect that the applicant would credit a program consistent with GALL XI.M18, Bolting Integrity. Therefore, in RAI 3.5-21, the staff requested the applicant to (1) identify all plant-specific applications of high strength bolting in Class I piping and component supports; (2) specifically describe the plant-specific operating experience related to SCC of high-strength bolting materials used in Class I piping and component supports; (3) describe the plant-specific resolution of the generic safety issue related to bolting integrity, including a description of any inspections/tests conducted as part of the resolution; and (4) if cracking due to SCC is an applicable aging effect, describe the inspections, in addition to IWF visual inspection, that will be credited to manage this aging effect.

In response to RAI 3.5-21, the applicant stated the following:

1) High strength bolting materials are used in various Class 1 piping and component supports which are identified in Section 6.8 of TR00170-003.

2) There is no plant specific operating experience related to Stress Corrosion Cracking (SCC) of high strength bolts at VCSNS.

3) VCSNS followed resolution of the generic safety issue as an EPRI member. EPRI Report NP-5769 states that utilities with bolting materials with specified yield strengths greater than 150 ksi should review their individual applications. A review and discussion on susceptibility of high strength bolting to SCC at VCSNS is contained in TR00170-003 (Sections 6.8 and 7.3), concluding that SCC is unlikely; therefore, not considered an applicable aging effect requiring management. Regardless, the examination requirements of ASME Section XI (IWF) are in place to adequately manage loss of function and cracking due to SCC for the Class 1 supports that are exposed to the Reactor Building environment.

4) The intent of the discussion in Application Section B.1.13.1 is that SCC is not considered an applicable aging effect for VCSNS requiring management. See additional discussions in Section 6.8.5 of TR00170-003. Regardless, the ASME Section XI ISI Program - IWF does exist in order to manage this aging effect. VCSNS also maintains an IWA program in accordance with ASME Section XI, which evaluates corrosion effects.

As a result of discussions with the applicant regarding the above response, the applicant provided the following supplemental response to RAI 3.5-21:

1) VCSNS followed resolution of the generic safety issue as an EPRI member and performed a review for applicability of SCC. As discussed in TR00170-003 (Section 6.8.5), Class 1 component supports could be susceptible to SCC if they meet all three conditional factors: high strength material, moist environment, and high level of sustained tensile stress (particularly with improperly heat treated anchor bolts). However, SCC is not considered as an applicable aging mechanism at VCSNS since high levels of sustained tensile stress do not exist for high strength bolting:

- ASTM A490 anchor bolt material was properly heat-treated by conforming to ASTM Specification A490 through a certified mill test report.
- Anchor bolts are tightened snug-tight as defined by AISC; therefore, for bolts greater than 1" in diameter, a significant preload (in the order of 70% of ultimate strength) is not practical to develop.
- Anchor bolts do not have a high level of sustained tensile stress as evidenced by lower faulted condition design loads due to elimination of dynamic effects subsequent to postulated High Energy Line Break (HELB) of the reactor coolant system primary coolant piping.

2) The IWF inspection program is not used at VCSNS to evaluate for SCC of high strength bolts. The IWF program was only mentioned since it is the primary inspection program for evaluating Class 1 supports, thereby providing some level of visual (VT-3) inspection of the adjacent bolts.

3) There has been no plant specific operating experience related to SCC of high strength bolts at VCSNS.

On the basis that (1) the necessary conditions for the development of SCC in high strength bolts do not exist at VCSNS and (2) there has been no plant-specific operating experience related to SCC of high strength bolts, the staff finds that augmented inspection for SCC of high strength bolts used in Class 1 supports is not warranted; inspection of Class 1 supports to the requirements of ASME Section XI, Subsection IWF is judged to be sufficient to manage aging for the period of extended operation.

<u>Conclusions</u>

On the basis of its review and audit of the applicants program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are

consistent with the GALL program. In addition, the staff has reviewed the exceptions to the GALL program and finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.5.2.3.4 Battery Rack Inspection Program

Summary of Technical Information in the Application

In LRA Section B.1.14, the applicant stated that the Battery Rack Inspection Program is a plant-specific program that is not addressed in GALL.

The Battery Rack Inspection Program (B.1.14) is included in the discussion column of LRA Table 3.5-2 and credited to manage aging effects for license renewal in Report TR00170-003, Revision 0, Attachment II for battery racks in the intermediate building and yard structures (fire service pumphouse).

Review of work orders for the past 5 years did not identify any instance where abnormal deterioration of battery racks occurred. No NCNs or CERs were initiated subsequent to inspections for battery racks.

The applicant concluded that the Battery Rack Inspection Program provides reasonable assurance that the aging effects for steel battery racks will be managed such that the components subject to AMR will continue to perform their intended functions consistent with the CLB for the period of extended operations.

Staff Evaluation

In LRA Section B.1.14, “Battery Rack Inspection,” the applicant described its AMP to manage aging in steel battery racks. This AMP is not addressed in GALL. The staff, therefore, reviewed this AMP against the 10 program elements using the guidance in BTP RLSB-1 in Appendix A of the SRP-LR. The staff also reviewed the FSAR supplement to determine whether it provides an adequate description of the program.

In the introduction to LRA Appendix B, the applicant stated that the VCSNS Quality Assurance Program implements the requirements of 10 CFR Part 50, Appendix B, and is consistent with the summary in Section A.2 of NUREG-1800, “Standard Review Plan for Review of License Renewal.” The applicant further stated that VCSNS will employ the corrective action and document control programs to address the program elements of corrective action, confirmation process, and administrative (document) controls for both safety-related and non-safety-related SCs that require aging management during the period of extended operation. The staff’s evaluation of the applicant’s Quality Assurance Program is discussed separately, and generically evaluated in Section 3.0.4 of this SER. Thus, these three elements are not discussed further in this section. The staff’s evaluation of the remaining seven elements is discussed below.

[Program Scope] The scope of the Battery Rack Inspection Program includes the battery racks for the electrical DC (ED) system (vital batteries) and the fire service (FS) system (diesel fire service pump battery). The applicant states that the regulatory basis for inspecting battery racks for the ED system is found in the VCSNS Technical Specifications Surveillance Requirement 3.8.2.1, while the regulatory basis for inspecting battery racks for the FS system is the commitment in the fire protection procedure. The staff finds the scope of the program acceptable since it identifies the specific structural components for which the program is credited for license renewal.

[Preventive Actions] The applicant identified the Battery Rack Inspection Program as a conditioning monitoring program. As such, there are no preventive actions, nor did the staff identify a need for such actions.

[Parameters Monitored or Inspected] The applicant stated that specific examination guidelines for the ED system and FS system battery racks are provided in IEEE-450. For the ED system and FS system, battery racks are inspected for loss of material due to corrosion. The applicant further stated that, although not credited for license renewal, the battery racks are also inspected for physical damage. The applicant explained that “physical damage” refers to “man-made damage.” The staff considers the parameters monitored to be acceptable since they are consistent with industry guidelines.

[Detection of Aging Effects] The applicant stated that the Battery Rack Inspection Program detects structural damage or degradation (including loss of material due to corrosion) prior to loss of structure intended function. The staff considers the applicant’s approach to the detection of aging effects to be acceptable since it is aimed at detecting aging effects before there is a loss of intended function.

[Monitoring and Trending] For the ED system, a visual examination is performed every 18 months in accordance with commitments in UFSAR Section 8.3.2.2.2 and Technical Specifications Surveillance Requirement 4.8.2.1.c. For the fire service system, visual examination is performed every 18 months in accordance with a commitment in the fire protection procedure. The applicant stated that the results of 18-month battery rack inspections are retained in sufficient detail to permit adequate confirmation of the inspection program. In particular these records identify inspectors, results of the inspections, note discrepancies with the cause, and prescribe corrective action. No actions are taken as part of this program to trend inspection or test results. The staff finds the inspection frequency and procedures for both systems to be acceptable. The surveillance procedure provides guidance when abnormalities are observed and the VCSNS Corrective Action Program is utilized to provide specific corrective and confirmatory actions.

[Acceptance Criteria] For both the ED and FS systems, the acceptance criterion is “no visual indication of loss of material due to corrosion,” as stated in a surveillance test procedure. The staff finds this acceptance criterion acceptable for visual inspections.

[Operating Experience] As discussed in SER Section 3.5.2.3.4, the operating experience with respect to battery racks has been good. The staff concludes that the Battery Rack Inspection program should be an effective program for license renewal.

<u>Conclusions</u>

On the basis of its review of the applicant's program, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.5.2.3.5 Containment Coating Monitoring and Maintenance Program

Summary of Technical Information in the Application

The applicant's Containment Coating Monitoring and Maintenance Program is discussed in LRA Section B.1.15, "Containment Coating Monitoring and Maintenance Program." The LRA credits this monitoring and maintenance program with maintaining the integrity of the protective coatings related to station containment, other structures, and component supports. The applicant stated that this program is consistent with the 10 program elements of GALL AMP XI.S8, "Protective Coating and Maintenance," with two clarifications. The first clarification is the applicant's determination of the program's acceptability since it meets the minimum scoping requirements of the GALL report (i.e., the program is based on RG 1.54). The second clarification is the applicant's alternate methodology, accepted by the NRC and documented in Section 3A of the VCSNS FSAR, for meeting the requirements of RG 1.54.

The following structures contain commodities/components for which this AMP is credited with managing the aging effect of loss of material due to coating degradation: reactor buildings, auxiliary building structures, control building, diesel generator building, fuel handling building, intermediate building, turbine building, and yard structures (including condensate storage tank foundation, fire service pumphouse, electrical manhole MH-2, electrical substation and transformer area).

In addition, the applicant stated that the Containment Coating Monitoring and Maintenance Program has demonstrated its capability to maintain the integrity of the protective coatings inside the reactor building. The applicant discussed the operating experience with coatings in containment and the ASME Section XI, Subsections IWE and IWL inspections conducted in 2000. These inspections are considered the baseline examination since previous inspections had not identified any significant problems. The IWE inspection revealed several areas of containment liner coating degradation, and documented these conditions in the site's nonconformance program. Most of the areas identified in the inspection were reworked per civil maintenance procedures. Those areas not repaired were judged to be of minimal significance; thereby not impacting performance. The applicant stated that these unrepaired areas will be monitored by periodic walkdown inspections at each outage and by augmented IWE inspections for any changes in condition that may suggest a loss of integrity or function.

The LRA cited NRC Generic Safety Issue 191, "Assessment of Debris Accumulation on PWR Sump Performance," but stated that the degradation of the coating is an issue under the current licensing basis and not a TLAA issue. The issue is dealt with through the response to Generic Letter (GL) 98-04, "Potential for Degradation of the Emergency Core Cooling System and the Containment Spray System after a Loss-of-Coolant Accident Because of Construction and Protective Coating Deficiencies and Foreign Material in Containment." The applicant further states that the monitoring and maintenance of Service Level I coatings conducted in

accordance with Regulatory Guide (RG) 1.54, "Service Level I, II, and III Protective Coatings Applied to Nuclear Power Plants," are effective for managing degradation and therefore, provide an effective means to manage loss of material due to corrosion of carbon steel inside containment. In its response to GL 98-04, the applicant stated that controls for the procurement, application, and maintenance of Service Level I protective coatings are implemented in a manner that is consistent with its licensing basis and regulatory requirements.

The LRA states in FSAR supplement 18.2.11 that the periodic visual walkdown inspections under this program are conducted from accessible floors, platforms, or other permanent vantage points. The degree of inspection depends upon accessibility, environmental and radiological conditions, and safety. In cases of inaccessibility, sampling approaches based on plant-specific characteristics, industry-wide experience, and testing history are evaluated in lieu of actual visual inspections.

Staff Evaluation

In LRA Section B.1.15, "Containment Coating Monitoring and Maintenance Program," the applicant describes this monitoring and maintenance program for maintaining the integrity of the protective coatings related to station containment, other structures, and component supports. The LRA states that this program is consistent with GALL AMP XI.S8, "Protective Coating and Maintenance." The applicant's claim of consistency with the GALL report was reviewed and verified during an AMR audit conducted on July 16 - 17, 2003. Based on the consistency of this program with the GALL report, the staff focused its review on the operating history program element supporting the effectiveness of this program.

[Operating History] The FSAR supplement for this program is described in Section 18.2.11 of Appendix A to the LRA and states that, for inaccessible areas, sampling approaches based on plant-specific characteristics, industry-wide experience, and testing history are evaluated in lieu of actual visual inspections. By letter dated March 28, 2003, the staff requested, in RAI B.1.15-1, the applicant to discuss the sampling procedures used to verify that the age-related degradation of the containment coating will be effectively managed in accordance with the current licensing basis during the extended period of operation. In addition, the staff requested information on Element 4, "Detection of Aging Effects," of the program in sufficient detail to allow an adequate assessment of this element or a justification for its inapplicability.

In its response dated June 12, 2003, the applicant stated that there are no specific "sampling procedures" used at VCSNS. The inspection team member(s) must select specific inaccessible areas for a closer inspection, or determine if visible accessible areas provide any indication that additional inspections are required in adjacent inaccessible areas. The applicant stated that this is consistent with inspection requirements of the Appendix J General Visual Inspection (LRA Section B.1.11), Containment ISI Program - IWE/IWL (LRA Section B.1.16) and Maintenance Rule Structures Program (LRA Section B.1.18). The requirements in these programs provide effective aging management of coatings under the CLB and during the extended period of operation. Pertinent to the detection of aging effects in Element 4, VCSNS: (a) conducts coatings inspections at a minimum frequency of each refueling outage or during other major maintenance outages; (b) ensures inspection team personnel are qualified; (c) conducts general visual walkthrough inspections, inspects previously designated areas, and inspects all coating in the vicinity of sumps and screens; and (d) documents the inspection results via condition evaluation reports or non-conformances. Appropriate personnel have

inspected containment coatings at a minimum frequency of each refueling outage. Engineering personnel have also participated in these inspections since about 1996. QC and Engineering personnel conducted an extensive inspection of containment coatings in 2000, as part of the Containment ISI Program - IWE/IWL (B.1.16) and Maintenance Rule Structures Program (LRA B.1.18). Under the provisions of these programs, inspections are made of all accessible areas using direct line of sight from permanent vantage points. The provisions also allow for random inspections of inaccessible areas such as behind structural attachments, cable trays and ductwork. These inspections identified several areas with coating deficiencies (failures) in accessible areas that were documented and/or corrected/repaired. The applicant determined that the operating experience presented no observations of coating deficiencies in any inaccessible areas.

The staff finds that while this AMP does not implement specific sampling procedures, it does include appropriate provisions to inspect inaccessible areas based on plant-specific operating history and qualified personnel. The inspections included in this program are consistent with the inspection process requirements of 10 CFR 50 Appendix J, ASME Section XI IWE/IWL, and the maintenance rule. In addition, the completion of a baseline coatings inspection in 2000 resulted in repaired or documented deficiencies in coatings. Coating deficiencies continue to be tracked and inspected as part of this AMP. The staff finds that these aspects of this AMP demonstrate its effectiveness in managing age-related degradation of the coatings. With respect to Element 4 for this AMP, the staff finds the applicant response consistent with the intent of the detection of aging effects program element described in the GALL report because qualified personnel complete the inspections periodically and document the results. Therefore, the staff considers RAI B.1.15-1 closed.

Based on the satisfactory resolution of RAI B.1.15-1 and the operating history discussion provided in the LRA, the staff finds the Containment Coating Monitoring and Maintenance Program consistent with the intent of GALL AMP XI.S8.

Section 18.2.11 of Appendix A to the LRA describes the applicant’s FSAR supplement for the Containment Coating Monitoring and Maintenance Program. The staff reviewed the summary description and finds that the information provided in the FSAR supplement for the aging management of systems and components discussed above is equivalent to the information in the GALL report, noting the two clarifications discussed above, and therefore, provides an adequate summary of the program activities as required by 10 CFR 54.21(d).

Conclusions

On the basis of its review and audit of the applicant’s program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.5.2.3.6 Containment Inservice Inspection Program — IWE/IWL

Summary of Technical Information in the Application

In LRA Section B.1.16, the applicant stated that the Containment ISI Program — IWE/IWL is consistent with XI.S1 ASME Section XI, Subsection IWE and XI.S2 ASME Section XI, Subsection IWL, as identified in NUREG-1801 with the following clarification:

- VCSNS uses the 1992 Edition of ASME XI with 1992 Addenda

The Containment ISI Program — IWE/IWL (B.1.16) is included in the discussion column of LRA Table 3.5-1 and credited to manage aging effects for license renewal in Report TR00170-003, Revision 0, Attachment II for the following components in the reactor building:

- liner plate
- penetrations (mechanical and electrical)
- personnel airlock, escape airlock, and equipment hatch
- reinforced concrete — beams, columns, floor slabs, walls

The program is also credited to manage aging effects for license renewal for the bellows and liner plate (RHR and spray system isolation valve chambers and guard pipes) in the auxiliary building.

Examinations for the first period of first interval were performed during RF-12 with satisfactory results. There were no LERs based on these examinations. NCNs and/or CERs were originated and dispositioned for the following conditions identified during these examinations:

- Containment Liner Coating Degradation (NCN) — Several areas of top coat were identified as degraded; however, the primer coat was intact with no signs of deterioration. The affected areas were cleaned and re-coated. Two areas of top coat in the dome were identified with initial signs of degradation. These areas have been identified for augmented inspections during future refueling outages.

- RHR and Spray Guard Pipe (CER) — Groundwater leakage identified at penetrations in the auxiliary building resulted in degradation (corrosion) of guard pipes. Subsequent evaluations determined that the guard pipe wall thickness remained acceptable. These areas have been identified for augmented inspections during future refueling outages.

- Concrete Leaching (CER) — Concrete leaching in the tendon access gallery has been attributed to groundwater seepage through cracks and construction joints within the surrounding fill concrete. One specific location was also identified with a minor corrosion buildup on the outer wall. Chemical analysis has determined that the groundwater is not aggressive. These areas have been identified for augmented inspections during future refueling outages.

- Moisture Barrier (CER) — Minor cracking and separation of the moisture barrier was identified at a few locations. These areas were repaired and/or replaced.

Augmented inspections were conducted during the April 2002 refueling outage for the above conditions. Additional CERs were originated for follow-up repair and/or replacement.

The applicant concluded that the Containment ISI Program — IWE/IWL provides reasonable assurance that the aging effects for the containment liner, associated moisture barriers, and the Reactor Building structure will be managed such that the components subject to AMR will continue to perform their intended functions consistent with the CLB for the period of extended operations.

Staff Evaluation

In LRA Section B.1.16, “Containment ISI Program - IWE/IWL,” the applicant described its AMP to manage aging in the containment liner, associated moisture barriers, and the reactor building structure. The LRA stated that this AMP is consistent with GALL AMPs XI.S1, “ASME Section XI, Subsection IWE,” and XI.S2, “ASME Section XI, Subsection IWL,” with the following clarification — VCSNS uses the 1992 Edition of ASME XI with 1992 Addenda. The staff reviewed the clarification to determine whether the AMP, with the clarification, remains adequate to manage the aging effects for which it is credited, and also reviewed the FSAR supplement to determine whether it provides an adequate description of the revised program. The staff audit on July 16–17, 2003, confirmed the applicant’s claim of consistency.

The Introduction to Appendix B, Aging Management Programs and Activities, of the LRA states that “clarification is provided for instances where the VCSNS program does not match specific details of a NUREG-1801 program element but is still determined to be consistent.” For this management program, a clarification is provided; however, it was not clear how the VCSNS program does not match the referenced GALL AMP. In RAI 3.5-18, the staff requested the applicant to explain what is intended by the above stated clarification to the program and confirm that the program is completely consistent with GALL.

In response to RAI 3.5-18, the applicant stated the following:

> Containment ISI Program - IWE/IWL (Application B.1.16) --- The clarification is no more than a statement that VCSNS uses the 1992 Edition of ASME Section XI Code with 1992 Addenda. This is consistent with GALL XI.S2 which states that the evaluations cover both the 1992 Edition with the 1992 Addenda and the 1995 Edition with the 1996 Addenda, as approved in 10 CFR 50.55a. VCSNS has not attempted to reconcile code differences nor requested approval for later editions.

The staff finds the applicant’s response to RAI 3.5-18, to be acceptable. The use of the 1992 Edition of ASME Section XI Code with 1992 Addenda is acceptable to the staff and consistent with GALL AMPs XI.S1, “ASME Section XI, Subsection IWE,” and XI.S2, “ASME Section XI, Subsection IWL.”

The staff noted several inconsistencies between the FSAR supplement summary descriptions of the AMPs in LRA Appendix A and the scope of the AMPs identified in LRA Appendix B as “consistent with GALL.” In RAI 3.5-19, the staff requested the applicant to verify that the complete scope of the AMP, as described in NUREG-1801, GALL Volume 2, is being credited to manage aging effects for license renewal. If this is not the case, the applicant was requested to identify and document the justification for each exception. In response to RAI 3.5-19, the applicant stated the following:

> As stated in the Application, VCSNS maintains an ASME Section XI - IWE/IWL Program (B.1.16), which is consistent with GALL XI.S1, XI.S2, and 10 CFR 50.55a.

> VCSNS does not believe that there are any further changes required for the Application Appendix A, since only summary statements are recommended by NEI 95-10. Commitment to all Regulations and Regulatory Guides are implicit in the development of each of these programs as described in Section 7 of TR00170-003.

Conclusions

On the basis of its review and audit of the applicants program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. In addition, the staff has reviewed the exceptions to the GALL program and finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.5.2.3.7 Flood Barrier Inspection Program

Summary of Technical Information in the Application

In LRA Section B.1.17, the applicant stated that the Flood Barrier Inspection Program is a plant specific program that is not addressed in GALL. The applicant further stated that the VCSNS Flood Barrier Inspection Program is identified for completeness since it contains individual components that have the unique function of mitigating the effects of internal flooding. All flood barrier components are managed by either the Fire Protection Program or Maintenance Rule Structures Program.

The Flood Barrier Inspection Program is included in the discussion column of LRA Table 3.5-2, but is not credited to manage aging effects for license renewal in Report TR00170-003, Revision 0, Attachment II.

No LERs, NCNs or CERs were initiated for flood barriers (walls, curbs, equipment pedestals), flood doors, and flood barrier penetration seals relevant to aging.

The applicant concluded that the Flood Barrier Inspection Program provides reasonable assurance that the aging effects for flood barrier components will be managed such that the components subject to AMR will continue to perform their intended functions consistent with the CLB for the period of extended operations.

Staff Evaluation

In LRA Section B.1.17, “Flood Barrier Inspection,” the applicant described its AMP to manage aging in flood barrier components. This AMP is not addressed in GALL. Therefore, the staff reviewed this AMP against the 10 program elements using the guidance in BTP RLSB-1 in Appendix A of the SRP-LR. The staff also reviewed the FSAR supplement to determine whether it provides an adequate description of the program.

In the introduction to LRA Appendix B, the applicant stated that the VCSNS Quality Assurance Program implements the requirements of 10 CFR Part 50, Appendix B, and is consistent with the summary in Section A.2 of NUREG-1800, “Standard Review Plan for Review of License

Renewal." The applicant further stated that VCSNS will employ the corrective action and document control programs to address the program elements of corrective action, confirmation process, and administrative (document) controls for both safety-related and non-safety-related SCs that require aging management during the period of extended operation. The staff's evaluation of the applicant's Quality Assurance Program is discussed separately, and generically evaluated in Section 3.0.4 of this SER. Thus, these three elements are not discussed further in this section. The staff's evaluation of the remaining seven elements is discussed below.

[Program Scope] In LRA Section B.1.17, the applicant stated that nuclear safety-related flood barriers are credited with mitigating the effects of internal flood. Nuclear safety-related flood barriers include curbs at entrances to cubicles housing safety grade equipment as stated in FSAR Section 6.3.2.2.7. Designated flood doors (watertight doors) are identified in plant specifications and are listed on architectural drawings. Ten doors are designated as flood doors (watertight doors). Penetrations requiring nuclear safety-related flood seals are specified in design basis documents. Penetrations requiring nuclear safety-related flood seals are shown on engineering drawings for the intermediate building, the control building, and the diesel generator building. Eleven penetrations require nuclear safety related flood seals.

As a result of its review, the staff found that the Flood Barrier Inspection Program described in LRA Section B.1.17 is included in the discussion column of LRA Table 3.5-2, but is not credited to manage aging effects for license renewal in Report TR00170-003, Revision 0, Attachment II: Aging Management Review Results for Structures and Structural Components. In RAI 3.5-22, the staff requested that the applicant provide additional information on the scope of the program. In response to RAI 3.5-22, the applicant stated the following:

> (a) As noted in Application Section B.1.17, "The VCSNS Flood Barrier Inspection Program is identified for completeness since it contains individual components that have the unique [sole] function of mitigating the effects of internal flooding. All flood barrier components are managed by either the Fire Protection Program or Maintenance Rule Structures Program." Component types include: concrete curbs, designated water-tight doors, and designated penetration seals. Flood barriers are located throughout the plant. See detailed discussion on flood barriers in Section 7.11 of TR00170-003.
>
> (b) There are currently no plant procedures written specifically for inspection of flood barriers. This program was added for license renewal to specifically capture those elements that only serve a flood protection function. There are many fire barriers (structures, doors, seals, etc.) that also serve as flood barriers and many structural components that serve as flood barriers, all of which are covered by the Fire Protection Program and Maintenance Rule Structures Program. Plant procedures for the Maintenance Rule Structures Program (B.1.18) will be enhanced to include inspections for flood barrier seals in the Control, Intermediate, and Diesel Generator Buildings in order to capture all flood barriers within the plant.
>
> (c) Section 7.11 of TR00170-003 agrees with the Application that there are flood seals in the Intermediate Building (IB). However, Attachment II (IB) of TR00170-003 and Application Table 2.4-7 (IB) do not list flood barriers (similar to the CB and DGB). The VCSNS Drains/Sumps DBD (Section 3.8.5.4) identifies one (1) flood barrier at the IB / TB interface. Therefore, flood barriers will be added as a line item to Attachment II (IB) of TR00170-003.

Based on the additional information provided by the applicant, the staff finds the scope of the program to be acceptable since it identifies the specific structural components for which the program is credited for license renewal. The applicant also defined the relationship of this program to the Fire Protection Program and the Maintenance Rule Structures Program and committed to changes to the programs that are acceptable to the staff.

[Preventive Actions] The applicant identified the Flood Barrier Inspection Program as a condition monitoring program. As such, there are no preventive actions, nor did the staff identify a need for such actions.

[Parameters Monitored or Inspected] The applicant stated that aging effects for flood barriers are cracks, exposed reinforcing steel, corrosion, scaling, popouts, surface pitting, and spalling. The applicant further stated that the aging effects for flood barrier penetration seals are similar to aging effects for fire barrier penetration seals and include cracking, fraying, separation from penetration, and through-wall holes. The staff finds the parameters monitored to be acceptable since they are consistent with the potential aging effects that would be associated with the structural components within the scope of the program.

[Detection of Aging Effects] The applicant stated that the Flood Barrier Inspection Program detects aging effects prior to loss of intended function. The staff considers the applicant's approach to the detection of aging effects to be acceptable since it is aimed at detecting aging effects before there is a loss of intended function.

[Monitoring and Trending] The applicant stated in LRA Section B.1.17 that visual examination of nuclear safety related flood barrier penetration seals that are also fire barrier penetration seals is performed once every 18 months as stated in surveillance test procedures. In response to RAI 3.5-22, the applicant provided the following additional information regarding the frequency of inspection of flood barriers:

> Flood barriers, which are not covered by the Fire Protection Program, are reviewed as part of the Maintenance Rule Structures Program which is conducted on a 5-year frequency.

The staff finds the inspection frequency and procedures for the program to be acceptable.

[Acceptance Criteria] The applicant stated that flood barrier and flood barrier penetration seal examination acceptance criteria are provided in an engineering services procedure for flood barriers that are not fire barriers. Acceptance criteria are no cracks, no exposed reinforcing steel, no corrosion, no scaling, no popouts, no surface pitting, and no spalling. Flood barrier penetration seal examination acceptance criteria are the same as for fire barrier penetration seals and are provided in a technical requirements package. Acceptance criteria are provided for indication of cracking, separation between surfaces at penetration, and no through-wall holes. The staff finds the acceptance criteria acceptable for visual inspection.

[Operating Experience] As discussed in SER Section 3.5.2.3.7, the operating experience with respect to flood barriers has been good. The staff concludes that the Flood Barrier Inspection Program should be an effective program for license renewal.

<u>Conclusions</u>

On the basis of its review of the applicant's program, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.5.2.3.8 Pressure Door Inspection Program

Summary of Technical Information in the Application

In LRA Section B.1.20, the applicant stated that the Pressure Door Inspection Program is a plant-specific program that is not addressed in GALL. The applicant further stated that pressure doors at VCSNS are used to separate critical equipment from high energy pipe breaks, and are designed, procured, and installed to specific specifications.

The Pressure Door Inspection Program is included in the discussion column of LRA Table 3.5-2, but is not credited to manage aging effects for license renewal in Report TR00170-003, Revision 0, Attachment II.

VCSNS has no failures or adverse trends for nuclear safety related or quality-related pressure doors. An occurrence of steam propagation into sensitive rooms through fire doors was identified. One door was replaced with a quality-related pressure resistant fire door, while a quality-related pressure resistant door was added at another location. No NCNs or CERs were initiated for pressure doors relevant to aging.

The applicant concluded that the Pressure Door Inspection Program provides reasonable assurance that the aging effects for pressure doors will be managed such that the components subject to AMR will continue to perform their intended functions consistent with the CLB for the period of extended operations.

Staff Evaluation

In LRA Section B.1.20, “Pressure Door Inspection Program,” the applicant described its AMP to manage aging in pressure doors. This AMP is not addressed in GALL. Therefore, the staff reviewed this AMP against the 10 program elements using the guidance in BTP RLSB-1 in Appendix A to the SRP-LR. The staff also reviewed the FSAR supplement to determine whether it provides an adequate description of the program.

In the introduction to LRA Appendix B, the applicant stated that the VCSNS Quality Assurance Program implements the requirements of 10 CFR Part 50, Appendix B, and is consistent with the summary in Section A.2 of NUREG-1800, “Standard Review Plan for Review of License Renewal.” The applicant further stated that VCSNS will employ the Corrective Action and Document Control Programs to address the program elements of corrective action, confirmation process, and administrative (document) controls for both safety-related and non-safety-related SCs that require aging management during the period of extended operation. The staff’s evaluation of the applicant’s Quality Assurance Program is discussed separately, and generically evaluated in Section 3.0.4 of this SER. Thus, these three elements are not discussed further in this section. The staff’s evaluation of the remaining seven elements is discussed below.

[Program Scope] The applicant stated in LRA Section B.1.20 that the need to maintain pressure barriers (which also serve as fire barriers) is required by VCSNS technical specification 4.7.6.e.3. There are 34 doors that are nuclear safety-related pressure resistant doors. Thirteen doors are quality-related pressure doors. There are 47 doors that are rated as pressure resistant.

As a result of its review, the staff found that the Pressure Door Inspection Program described in LRA Section B.1.20 is included in the discussion column of LRA Table 3.5-2, but is not credited to manage aging effects for license renewal in Report TR00170-003, Revision 0, Attachment II: Aging Management Review Results for Structures and Structural Components. In RAI 3.5-24, the staff requested that the applicant provide additional information on the scope of this program.

In response to RAI 3.5-24, the applicant stated the following:

> (a) Pressure and Fire doors are located throughout the plant. Pressure doors, which also serve as Fire doors, are inspected under the Fire Protection Program. Pressure doors which only serve a pressure function are inspected under plant maintenance procedures for quality related pressure barrier / components. See discussion in Section 7.14 of TR00170-003.
>
> (b) Attachment II of TR00170-003 lists component types: "Flood, Pressure and Specialty Doors", all of which are in general inspected under the Maintenance Rule Structures Program. The RAI observation is correct that either the Fire Protection Program or the Pressure Door Inspection Program (both of which will be added to Attachment II of TR00170-003) inspects pressure doors in detail.

Based on the additional information provided by the applicant, the staff finds the scope of the program to be acceptable since it identifies the specific structural components for which the program is credited for license renewal.

[Preventive Actions] The applicant identified the Pressure Door Inspection Program as a condition monitoring program. As such, there are no preventive actions, nor did the staff identify a need for such actions.

[Parameters Monitored or Inspected] In LRA Section B.1.20, the applicant stated that parameters monitored for pressure doors are loss of material of doors and door hardware. The applicant also stated that excessive wear for door appurtenances, such as latches, gaskets, hinges, sills, and closing devices, are additional attributes in the technical requirements package, but are not credited for license renewal. However, LRA Appendix A, Section 18.2.24 states that pressure door inspection attributes include freedom of movement, function (closed during normal plant operation), structural deterioration, and loss of door/door hardware material." In RAI 3.5-24, the staff requested that these inconsistencies be clarified.

In response to RAI 3.5-24, the applicant stated the following:

> Application Section B.1.20 provides more explicit details related to inspection criteria (including excessive wear of door appurtenances), while Appendix A Section 18.2.24 provides only a very generic description of the program. The summary provided in Appendix A should not be interpreted as eliminating wear from inspections. Consistent with NEI 95-10, VCSNS does not see the need to make these two sections read the same.

As a result of discussions with the applicant regarding the above response, the applicant provided the following supplemental response to RAI 3.5-24 Part (c):

> RAI 3.5-24(c) – The NRC Staff questioned the intent of statements made in Application Section B.1.20 under "Parameters Monitored or Inspected" relative to "excessive wear" being credited for license renewal.
>
>> 1) Excessive wear for door appurtenances (such as latches, gaskets, hinges, sills, and closing devices) is an inspection attribute which is inherent within the VCSNS procedures. These hardware components are included within the plant inspection procedures for fit, contact, closure and clearance, which inherently provides acceptance relative to wear.

> 2) The statement ["but are not credited for license renewal"] at the end of Application Section B.1.20 (Parameters Monitored or Inspected) was originally intended to imply that loss of material due to wear is not considered as an aging effect, but rather a consequence of frequent or rough use. Regardless, as noted in 1) above, excessive wear is an inspection attribute inherently included within plant inspection procedures.

The applicant's supplemental response clarifies that inspection of door appurtenances for excessive wear will be conducted during the period of extended operation. The staff finds this to be acceptable.

[Detection of Aging Effects] The applicant stated that the pressure door inspection program detects structural damage or degradation, including loss of material due to corrosion prior to loss of intended function. The staff considers the applicant's approach to the detection of aging effects to be acceptable since it is aimed at detecting aging effects before there is a loss of intended function.

[Monitoring and Trending] The applicant stated that aging effects for quality-related pressure doors are detected by a visual examination of the door and frame and functional testing for closure. Aging effects for nuclear safety related pressure doors are detected by visual examination. No actions are taken as part of this program to trend inspections or test results. The applicant further stated that the frequency of inspections performed since the implementation of the technical specifications requirements in 1984 is acceptable based on industry operating experience. A review of pressure door inspections confirms the reasonableness and acceptability of this inspection frequency such that any degradation of a door is detected prior to loss of function.

In response to RAI 3.5-24, the applicant provided the following information regarding the frequency of inspection for pressure doors:

> Pressure doors, which serve as Fire doors are inspected every 6 months, while Pressure doors, which only serve a pressure function, are inspected every 18 months.

The staff finds the inspection frequency and procedures for pressure doors to be acceptable. If the results of the visual inspection indicate that repairs are required, then specific repairs are made in accordance with plant procedures. The pressure door inspections are implemented by plant procedures and controlled by the SCE&G Quality Assurance Program.

[Acceptance Criteria] The applicant stated that quality-related pressure door acceptance criteria is provided in technical requirement packages. Nuclear safety-related pressure door acceptance criteria is provided in surveillance test procedures. Acceptance criteria for self-closing doors are that hinges are intact with all screws tight, pins in good condition, and the door closes. Acceptance criteria for double self-closing doors are that bolts are in good condition, the astragal (metal molding strip) is in good condition, and the door closes. Automatic-closing doors are checked to be in good operating condition and the door closes. Acceptance criteria for hollow pressure doors are no holes and no damage in the skin of the door or the frame. The staff finds the acceptance criteria to be acceptable.

[Operating Experience] As discussed in SER Section 3.5.2.3.8, the operating experience with respect to pressure doors has been good. The staff concludes that the Pressure Door Inspection Program should be an effective program for license renewal.

Conclusions

On the basis of its review of the applicant's program, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.5.2.3.9 Service Water Pond Dam Inspection Program

Summary of Technical Information in the Application

In LRA Section B.1.21, the applicant stated that the Service Water Pond Dam Inspection Program is consistent with XI.S7, RG 1.127 Inspection of Water-Control Structures Associated With Nuclear Power Plants, as identified in NUREG-1801. The applicant further stated that certain enhancements will be incorporated into the Service Water Pond Dam Inspection Program prior to the period of extended operation. In particular, North Dam piezometers will be added to the scope with the following program attributes:

- [Parameters Monitored or Inspected] — water level

- [Monitoring and Trending] — inspections will be made every 5 years concurrent with the RG 1.127 inspections

- [Acceptance Criteria] — nominal elevation of adjacent service water pond and Monticello Reservoir

The Service Water Pond Inspection Program is included in the discussion column of LRA Table 3.5-2 and credited to manage aging effects for license renewal in Report TR00170-003, Revision 0, Attachment II for the service water pond dams (North Dam, South Dam, East Dam, and West Embankment).

During each inspection of the service water pond dams and West Embankment, a review of the previous inspection's observations/recommendations is performed and the current status (such as repairs implemented or continued monitoring) is documented. Previous abutment erosion control modifications completed in 1989 significantly reduced earlier erosion problems overall, as noted by inspections performed in 1990 and 1995. Additional grading of diversion trenches/berms to direct rainwater away from the dams has further controlled erosion. There are currently no erosion areas that have a direct impact on any of the earthen structures. Weed, brush, and sapling growth are controlled via cutting or spraying of herbicides conducted in accordance with plant procedures.

Structural calculations document the results of the survey monitoring data for the North and South Dam, and West Embankment. The calculations provide a review of the vertical and horizontal displacements of the service water pond North Dam and South Dam since 1977. The calculations also provide a review of the vertical displacement of the West Embankment since 1978 and the horizontal displacement of the West Embankment since 1983. For the 2000 survey, all vertical and horizontal displacements were within the acceptance criteria as

compared to the previous survey and found to be acceptable. Structural calculations also provide a review of the slope survey of the West Embankment since 1983. For the 2000 survey, all of the measurements were within the acceptance criteria as compared to the previous survey and found to be acceptable. No further evaluations were required and no unusual trends were noted.

In addition to the 5-year inspection of the service water pond dams required by the NRC, Federal Energy Regulatory Commission (FERC) conducted inspections of the service water pond dams in February 1997, July 1999, and July 2001. The conclusions reached by these inspections were that no significant conditions were observed that were considered detrimental to the safety of the dams. The 1997 FERC dam safety inspection report recommended that SCE&G visually inspect the Service Water Pond Dams and West Embankment annually and test the accessible piezometers. The annual visual inspection is scheduled for the fall of each year. The first annual visual inspection and testing of the accessible piezometers was conducted in November 1999. Three accessible piezometers located along the crest of the North Dam were tested and found to be functional with acceptable results.

The applicant concluded that the Service Water Pond Dam Inspection Program has been demonstrated to be capable of detecting and managing trends in movement and the effects of aging for the service water dams. The applicant further concluded that the Service Water Pond Dam Inspection Program provides reasonable assurance that the aging effects will be managed such that the components subject to AMR will continue to perform their intended functions consistent with the CLB for the period of extended operations.

Staff Evaluation

In LRA Section B.1.21, “Service Water Pond Inspection Program,” the applicant described its AMP to manage trends in movement and the effects of aging for the service water dams. The LRA stated that this AMP is consistent with GALL AMP XI.S7, “RG 1.127 Inspection of Water-Control Structures Associated With Nuclear Power Plants,” with several enhancements described in Section 3.5.2.3.9. The staff will confirm the applicant’s claim of consistency during the AMR inspection. Furthermore, the staff reviewed the enhancements to determine whether the AMP, with the enhancements, remains adequate to manage the aging effects for which it is credited, and reviewed the FSAR supplement to determine whether it provides an adequate description of the revised program.

The staff noted several inconsistencies between the FSAR supplement summary descriptions of the AMPs in LRA Appendix A and the scope of the AMPs identified in LRA Appendix B as “consistent with GALL.” In RAI 3.5-19, the staff requested the applicant to verify that the complete scope of the AMP, as described in NUREG-1801, GALL Volume 2, is being credited to manage aging effects for license renewal. If this is not the case, the applicant was requested to identify and document the justification for each exception. In response to RAI 3.5-19, the applicant stated the following:

> As stated in the Application, VCSNS maintains a Service Water Pond Dam Inspection Program (B.1.21), which is consistent with GALL XI.S7 and RG 1.127. One enhancement to this program was identified during a NRC/FERC inspection as identified in the Application and discussed in Section 7.15 of TR00170-003.

> VCSNS does not believe that there are any further changes required for the Application Appendix A, since only summary statements are recommended by NEI 95-10. Commitment to all Regulations and Regulatory Guides are implicit in the development of each of these programs as described in Section 7 of TR00170-003.

LRA Section B.1.21 states that the Service Water Pond Dam Inspection Program is consistent with GALL XI.S7 with several listed enhancements that will be incorporated into the program prior to the period of extended operation. In RAI 3.5-25, the staff requested that the applicant provide the following information regarding this program:

1. The commitment to incorporate the enhancements to this program discussed in LRA Section B.1.21 should also be included in the FSAR supplement, Appendix A, Section 18.2.31. This section does not currently include such a commitment. Issues related to the FSAR supplement are being addressed by the staff on a generic basis.

2. The discussion in LRA Section B.1.21.1 on operating experience does not include the East Dam. Please provide a discussion on the operating experience for the East Dam.

In response to RAI 3.5-25, the applicant stated the following:

> (a) Consistent with NEI 95-10, VCSNS does not see the need to include these minor enhancements into the very generic summary description of the Service Water Pond Dam Inspection Program (Application Section 18.2.31).
>
> (b) The East Dam of the Service Water Pond (SWP) is the smallest and least critical (important) of the four SWP dams since it primarily caps a natural high elevation ridge line along the east side of the pond. There are no piezometers or alignment/survey monuments for this structure. The East Dam is inspected as part of the Service Water Pond Dam Inspection Program. There are no operating experience issues associated with this dam other than normal observations of minor erosion and weed growth at the edges of the riprap protection.

The staff finds the applicant's discussion on operating experience for the East Dam to be acceptable.

Conclusions

On the basis of its review and audit of the applicants program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. In addition, the staff has reviewed the enhancements to the GALL program and finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.5.2.3.10 Service Water Structures Survey Monitoring Program

Summary of Technical Information in the Application

In LRA Section B.1.22, the applicant stated that the Service Water Structures Survey Monitoring Program is a plant specific program that is not addressed in GALL. The applicant further stated that survey monitoring is required for structures that are supported by earthen fill

material and that have exhibited the potential for settlement. Settlement is not considered adverse unless it imposes stresses on structures that may exceed their design capacities. Initial settlement of the service water pump house (SWPH) and the service water intake structure (SWIS) was much more than the original preconstruction estimates. As a result, survey monitoring of the SWPH, SWIS, electrical duct banks, and service water intake line “A” is conducted to monitor any differential in vertical and horizontal displacement. This monitoring is conducted to satisfy the requirements specified by operating license condition 2.C.5 and FSAR Section 2.5.4.10.6.2.

The Service Water Structures Survey Monitoring Program is included in the discussion column of LRA Table 3.5-2 and credited to manage aging effects for license renewal in Report TR00170-003, Revision 0, Attachment II for the foundations and intake bays or canals for the SWPH, SWIS, electrical duct banks, and service water intake line “A.”

Initial settlement of the SWPH and SWIS was much more than the original preconstruction estimates. The degree and manner of settlement caused cracking to occur in the SWIS, which was subsequently repaired (grouted). A special settlement study was performed for the SWPH and SWIS. There has been no significant settlement of the SWPH or SWIS since December 1978, subsequent to filling the service water pond in February 1978.

Since 1991, there have been two instances where movement of the SWPH exceeded the acceptance criteria. The first instance was in February 1991; a resurvey was conducted in March 1991 and it was determined that the initial survey data was in error. In the second instance (July 1994), the acceptance criterion was minimally exceeded. Considering survey process inaccuracy and seasonal fluctuations affecting data collection, the total differential was not considered significant enough to warrant further evaluation. Survey results from 1977 to the present are documented in structural calculations.

Survey monitoring for differential settlement (middle to ends) of the SWIS has been conducted since February 1985. Between the July 1985 survey and February 1986 survey of the SWIS there was a sudden increase in the recorded differential displacement for which no ready explanation could be found. As a result of this sudden change, the survey monitoring frequency was increased to monthly for a period of 8 months and the results showed the differential movement remained steady. Consequently, the frequency of monitoring was returned back to semiannually. No further significant increase in differential movement has been recorded since February 1986 and the total settlement to date is within the acceptance limit.

No significant differential settlement was expected between the SWPH and incoming buried services, as these were intentionally laid and connected to the SWPH after the major initial settlement during construction, and the effects of filling the service water pond in February 1978 had ceased. However, semiannual survey data are recorded and evaluated.

Settlement of the electrical duct banks is measured from inside the SWPH where the duct banks terminate on the inside face of the west wall of the SWPH. Historically, gap measurements have not undergone any significant changes since monitoring began, with any differential measurements well within the established acceptance criteria. Survey results are documented in structural calculations.

Service water intake line “A” settlement has been monitored since January 1983. Since then there has been no appreciable movement or trend based on data reviews. However, there have been three occasions, one each in 1996, 1999, and 2000, when the acceptance criteria was minimally exceeded. These conditions are considered acceptable since the overall measurements remain within the general bounds of the long-term trend of data. The applicant states that these minor fluctuations may well be attributed to survey process imprecision, seasonal changes between summer and winter surveys, or groundwater fluctuations. Survey results are documented in structural calculations.

The applicant concluded that the Service Water Structures Survey Monitoring Program has been demonstrated to be capable of detecting and managing trends in movement associated with settlement of the service water structures. The applicant further concluded that the Service Water Structures Survey Monitoring Program provides reasonable assurance that the aging effects will be managed such that the components subject to AMR will continue to perform their intended functions consistent with the CLB for the period of extended operations.

Staff Evaluation

In LRA Section B.1.22, “Service Water Structures Survey Monitoring Program,” the applicant described its AMP to manage trends in movement associated with settlement of service water structures. This AMP is not addressed in GALL. Therefore, the staff reviewed this AMP against the 10 program elements using the guidance in BTP RLSB-1 in Appendix A to the SRP-LR. The staff also reviewed the FSAR supplement to determine whether it provides an adequate description of the program.

In the introduction to LRA Appendix B, the applicant stated that the VCSNS Quality Assurance Program implements the requirements of 10 CFR Part 50, Appendix B, and is consistent with the summary in Section A.2 of NUREG-1800, “Standard Review Plan for Review of License Renewal.” The applicant further stated that VCSNS will employ the corrective action and document control programs to address the program elements of corrective action, confirmation process, and administrative (document) controls for both safety-related and non-safety-related SCs that require aging management during the period of extended operation. The staff’s evaluation of the applicant’s Quality Assurance Program is discussed separately, and generically evaluated in Section 3.0.4 of this SER. Thus, these three elements are not discussed further in this section. The staff’s evaluation of the remaining seven elements is discussed below.

[Program Scope] The scope of the program includes survey monitoring of the SWPH, SWIS, electrical duct banks, and service water intake line “A” in accordance with plant procedures. The staff finds the scope of the program to be acceptable since it identifies the specific structures and structural components for which the program is credited for license renewal.

[Preventive Actions] The applicant identified the survey monitoring of the SWPH, SWIS, electrical duct banks, and service water intake line “A” as a condition monitoring program. As such, there are no preventive actions, nor did the staff identify a need for such actions.

[Parameters Monitored or Inspected] The applicant stated that survey monitoring is conducted to detect any vertical and/or horizontal movement associated with settlement of the SWPH, SWIS, electrical duct banks, and service water intake line “A”. The survey monitoring data are

reviewed by design engineering to ensure that settlements remain within established criteria. In addition to survey monitoring, the structures are visually inspected in accordance with engineering services procedures for the following:

- SWPH movement, alignment or sloughing, cracking, settlement, and structural degradation,
- SWIS cracking (per underwater diver's inspection),
- service water electrical duct bank differential movement and integrity of the expansion joint material,
- ground above service water intake line "A" is inspected for settlement, sloughing, surface cracking, and erosion

The staff finds that the parameters monitored are acceptable and consistent with what would be expected for a settlement monitoring program.

[Detection of Aging Effects] The applicant stated that attributes associated with aging for the SWPH, SWIS, electrical duct banks, and service water intake line "A" are detected by the survey monitoring. The survey results are reviewed and evaluated for trends in movement associated with settlement that exceeds the acceptance criteria. This review, and the visual inspection of the structures, will detect any adverse horizontal or vertical displacements prior to the loss of structure intended functions. The staff finds the applicant's approach to detection of settlement effects to be acceptable since it is aimed at detecting such effects before there is a loss of function.

[Monitoring and Trending] Aging effects associated with settlement for the SWPH, SWIS, electrical duct banks, and service water intake line "A" are detected by survey monitoring in accordance with CLB requirements. Survey monitoring data are retained in sufficient detail to permit adequate confirmation of the inspection program. The survey data reports and reviews/evaluations are filed in structural calculations. In particular these records identify the person(s) performing the survey, the structure/component and points surveyed, the person(s) reviewing/evaluating the survey data, whether or not the results are acceptable, discrepancies and their causes, and any corrective action(s) taken as a result. Trending is accomplished by comparing the current survey data to the previous survey data and evaluating for trends in movement that exceed the acceptance criteria. The staff finds the applicant's approach acceptable since it will continue to be in accordance with CLB requirements that have proven to be acceptable as evidenced by plant operating experience, as discussed in SER Section 3.5.2.3.10.

[Acceptance Criteria] The acceptance criteria and guidelines for reviewing the survey settlement data for the SWPH, SWIS, electrical duct banks, and service water intake line "A" are specified in design engineering guidelines. Survey results are evaluated for adverse trends in vertical displacement. The measurements are compared to the previous survey results and to acceptance criteria defined in engineering guidelines. The SWIS is also monitored for differential displacement between the middle and ends of the tunnel. If the acceptance criterion for the differential displacement is reached or exceeded, further engineering evaluations are

required. The staff did not identify any need to modify the current acceptance criteria which are based on current CLB requirements.

[Operating Experience] As discussed in SER Section 3.5.2.3.10, operating experience has demonstrated that the Service Water Structures Survey Monitoring Program has been effective in monitoring the potential for settlement of service water structures. The staff concludes that this program should continue to be an effective program for license renewal.

Conclusions

On the basis of its review of the applicant's program, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.5.2.3.11 Underwater Inspection Program (SWIS and SWPH)

Summary of Technical Information in the Application

In LRA Section B.1.23, the applicant stated that the Underwater Inspection Program (SWIS and SWPH) is a plant-specific program that is not addressed in GALL.

The Underwater Inspection Program (SWIS and SWPH) is included in the discussion column of LRA Table 3.5-2 and credited to manage aging effects for license renewal in Report TR00170-003, Revision 0, Attachment II for the following components of the SWIS and SWPH:

- intake bays or canals
- intake screens
- reinforced concrete — beams, columns, floor slabs, walls

VCSNS operating license condition 2.C.5.d requires SCE&G to perform an inspection of the SWIS every 5 years to monitor and measure the cracks in the reinforced concrete tunnel, which originated due to settlement problems during construction.

Cracks in the SWIS (tunnel), which were identified during construction, were grouted with a high strength epoxy grout in 1978 prior to filling the service water pond. Underwater inspections were initiated in 1983 and have been performed every 5 years. The inspections of 1983 and 1988 identified very little change in the existing grouted and ungrouted cracks, along with a few new hairline cracks. An improved method of marking old cracks was implemented during 1988, with additional improvements made during the 1993 inspection, which allows better distinction of old versus new ungrouted cracks.

The 1993 inspection also identified nine existing cracks that had widened and four cracks with a maximum width greater than the minimum criteria. These cracks were evaluated and documented in a structural calculation. The cracks were grouted in 1994 with a flexible urethane grout in order to eliminate/reduce the potential for corrosion of the reinforcing steel. No new cracks were identified during the 1998 inspection and all cracks that had any visible

gap were measured to be less than the minimum criteria. The 1998 inspection data for each crack was compared to the results of the 1993 inspection to ensure consistency and no significant differences were noted between the two inspection reports.

After filling the service water pond, visual inspection and cleaning of the SWIS and SWPH was performed once each refueling cycle within the preventive maintenance program. In response to GL 89-13, a new engineering procedure was developed to direct the SWIS and SWPH inspections. A review of the inspection data for the past 5 years shows that no corrosion has been discovered on the trash racks, foot section of each traveling screen, endbell of each service water pump, and/or other submerged structural components. The location and density of fouling accumulations (e.g., silt and clams) is recorded and subsequently removed by divers using an eductor.

The applicant concluded that the Underwater Inspection Program (SWIS and SWPH) has been demonstrated to be capable of detecting and managing the effects of aging for concrete components in fluid environments. The applicant further concluded that the Underwater Inspection Program of the SWIS and SWPH provides reasonable assurance that the aging effects will be managed such that the components subject to AMR will continue to perform their intended functions consistent with the CLB for the period of extended operations.

Staff Evaluation

In LRA Section B.1.23, “Underwater Inspection Program (SWIS and SWPH),” the applicant described its AMP to manage aging for concrete and steel components in fluid environments. This AMP is not addressed in GALL. Therefore, the staff reviewed this AMP against the 10 program elements using the guidance in BTP RLSB-1 in Appendix A to the SRP-LR. The staff also reviewed the FSAR supplement to determine whether it provides an adequate description of the program.

In the introduction to LRA Appendix B, the applicant stated that the VCSNS Quality Assurance Program implements the requirements of 10 CFR Part 50, Appendix B, and is consistent with the summary in Section A.2 of NUREG-1800, “Standard Review Plan for Review of License Renewal.” The applicant further stated that VCSNS will employ the corrective action and document control programs to address the program elements of corrective action, confirmation process, and administrative (document) controls for both safety-related and non-safety-related SCS that require aging management during the period of extended operation. The staff’s evaluation of the applicant’s Quality Assurance Program is discussed separately, and generically evaluated in Section 3.0.4 of this SER. Thus, these three elements are not discussed further in this section. The staff’s evaluation of the remaining seven elements is discussed below.

[Program Scope] The scope of the SWIS underwater inspection, conducted in accordance with engineering services procedures, includes visual inspection of the interior length of the intake tunnel, survey monitoring masts, trash racks, access ladder, and east end wing walls. The scope of the SWPH underwater inspection, conducted in accordance with engineering services procedures, includes a visual inspection of the intake tunnel, traveling screens/bays, and service water pump bays. In response to RAI 3.5-26 parts (a) and (b), the applicant provided the following additional information regarding the scope of the program:

(a) For the Service Water Pumphouse (SWPH) and Intake Structure (SWIS) at VCSNS, the primary inspections for aging management are the Underwater Inspection Program (B.1.23) and the Maintenance Rule Structures Program (B.1.18). These two programs provide a very detailed review and documentation of these structures. The Service Water Pond Dam Inspection Program (B.1.21) also incorporates walkdowns of the SWPH (at different frequencies) using the attributes of GALL XI.S7. Use of a statement that B.1.21 is supplementary does not imply that program attributes have been omitted.

(b) The program attributes discussed in Application Section B.1.23 are primarily focused on the SWIS since explicit inspection criteria have been incorporated as part of the CLB Operating License conditions for VCSNS. Detailed Engineering Services inspection procedures and acceptance criteria have also been developed. The diver's inspection of the SWPH (controlled by Plant Support procedures) serves primarily as a maintenance clean-up of the pump bays and screens, with instructions to look for any signs of degradation.

The staff finds the scope of the program to be acceptable since it identifies the specific structures and structural components for which the program is credited for license renewal. The applicant's response resolves the staff's concern as to whether the Underwater Inspection Program incorporates the attributes described in GALL XI.S7. The use of the Service Water Pond Dam Inspection Program for supplementary review is acceptable since the applicant's response confirms that no attributes of GALL XI.S7 have been omitted.

[Preventive Actions] The applicant identified the Underwater Inspection Program (SWIS and SWPH) as a condition monitoring program. As such, there are no preventive actions, nor did the staff identify a need for such actions.

[Parameters Monitored or Inspected] Guidelines for the underwater inspection of the SWIS and SWPH are specified in engineering services procedures. The main reason for inspecting the SWIS is to measure/monitor cracks (old and new) in the concrete structure that originated due to earlier settlement. Additionally, a general inspection of the structure is made to document the as-found condition, noting any unusual observations. The specific areas that are inspected (and for which the condition is documented) are the access ladder, trash racks, survey monitoring masts, and concrete wing walls at the intake end of the SWIS. Underwater inspections of the SWIS and SWPH monitor corrosion and fouling within the service water system. The SWIS and the SWPH forebay area, traveling screen bays, and service water pump bays are inspected for fouling (clam and silt) accumulations. The density of the accumulation is documented and subsequently removed. The submerged trash racks, traveling screen components, service water pump components, and other structural components are inspected for corrosion. Any corrosion observed is documented in the inspection report. The staff finds the description of the parameters monitored to be acceptable and appropriate for an underwater monitoring program.

[Detection of Aging Effects] The applicant stated that attributes associated with aging for the SWIS and SWPH are detected by the underwater inspections. Additionally, survey monitoring of the SWIS and SWPH will detect any horizontal or vertical movement associated with settlement. In response to RAI 3.5-26 parts (c) and (e), the applicant provided the following additional information regarding the detection of aging effects:

(c) The VCSNS procedures for inspection of the SWIS are focused on cracking within the concrete tunnel. Divers are also instructed to look for any structural damage such as concrete spalls or pieces on the floor. These are the primary "attributes associated with aging" which can be identified via diver inspections. The divers recover all trash/debris in the tunnel such that if concrete pieces were recovered, engineering would require additional inspections.

> (e) As previously discussed, the diver's inspection of the SWPH is primarily for clean up of the pump bay and screen areas. The divers inspect for corrosion and fouling accumulations. Recovery of any unusual debris (such as pieces of concrete) would lead to additional inspections.

The staff considers the applicant's approach to the detection of aging effects to be acceptable since it is aimed at detecting aging effects before there is a loss of intended function.

[Monitoring and Trending] The applicant stated that the underwater inspection reports are retained in sufficient detail to permit adequate confirmation of the inspection programs. The SWIS inspection documentation and reviews/evaluations are filed in structural calculations. In particular, these records include the subcontractor's underwater inspection report, design engineering review and evaluation of the results, comparison with previous inspection results, and whether or not the results are acceptable. Discrepancies and their cause, and any corrective action resulting from these inspections, are also documented in the calculations. In response to RAI 3.5-26 part (d), the applicant provided the following additional information:

> (d) The detailed divers inspection of the SWIS occurs every five years, and includes an underwater inspection of the SWPH. The underwater cleanup inspection of the SWPH bays and screens occurs every outage (18 months).

The staff finds the inspection frequency and procedures to be acceptable.

[Acceptance Criteria] The acceptance criteria for the underwater inspection of the SWIS is that the inspection data are reviewed by engineering. Cracks (old and new) are documented and mapped on an engineering procedure attachment. Crack width is measured using wire gauges on a "Go – No/Go" basis by inserting the wire into the crack. The following additional information concerning acceptance criteria is provided in TR00170-003:

> Any changes in length or width to existing (old) cracks and any new cracks are reported by SCE&G to the NRC in accordance with Operating License Condition 2.C.5.d.
>
> The acceptance criteria for the underwater inspection of the SWIS and SWPH is that the diver's inspection data is reviewed by Plant Support Engineering. Any accumulation of biofouling (silt or clams) is removed. Engineering evaluates any corrosion on the traveling screen components, service water pump components or any other structural component that was noted on the inspection checklist. Any corrective action(s) based on the results of this evaluation are initiated by engineering.

The staff finds the acceptance criteria to be acceptable since they are based on CLB requirements and the staff did not identify any need to modify the criteria for license renewal.

[Operating Experience] As discussed in SER Section 3.5.2.3.11, operating experience has demonstrated that the Underwater Inspection Program has been effective in managing the effects of aging of underwater structural components associated with the SWIS and SWPH. The staff concludes that this program should be an effective program for license renewal.

Conclusions

On the basis of its review of the applicant's program, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP

and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.5.2.3.12 Tendon Surveillance Program

Summary of Technical Information in the Application

In LRA Section B.3.3, the applicant stated that the Tendon Surveillance Program is consistent with X.S1, "Concrete Containment Tendon Prestress," as identified in NUREG-1801.

The Tendon Surveillance Program is included in the discussion column of LRA Table 3.5-1 and credited to manage aging effects for license renewal in Report TR00170-003, Revision 0, Attachment II for the post-tensioning system of the reactor building.

The test results from the first three surveillance's (1982, 1983, 1985) indicated that the wire relaxation force losses in the tendon system were greater than that which were predicted during design. Consequently, in June 1988, the predicted wire relaxation force losses were increased from 8.5 percent to 12.8 percent. The fourth period (10th year) tendon surveillance was performed during January–April 1990. In addition, the vertical tendons were retensioned because the previous surveillance data indicated that the vertical tendon forces would be below the technical specifications minimum prior to the fifth period surveillance.

The surveillance reports for the past three surveillance periods [fourth (1990), fifth (1996), and sixth (2000)] have each concluded that no abnormal degradation of the post-tensioning system has occurred at VCSNS.

The applicant concluded that the Tendon Surveillance Program has been demonstrated to be capable of maintaining the reactor building dome, vertical, and hoop tendons above the minimum required prestressing forces. The applicant further concluded that the Tendon Surveillance Program provides reasonable assurance that the aging effects will be managed such that the components subject to AMR will continue to perform their intended functions consistent with the CLB for the period of extended operation.

Staff Evaluation

In LRA Section B.3.3, "Tendon Surveillance Program," the applicant described its AMP to maintain the reactor building dome, vertical, and hoop tendons above the minimum required prestressing forces. The LRA stated that this AMP is consistent with GALL AMP X.S1, "Concrete Containment Tendon Prestress," with no deviations. The staff also reviewed the FSAR supplement to determine whether it provides an adequate description of the program. The staff audit on July 16-17, 2003, confirmed the applicant's claim of consistency.

The staff noted several inconsistencies between the FSAR supplement summary descriptions of the AMPs in LRA Appendix A and the scope of the AMPs identified in LRA Appendix B as "consistent with GALL." In RAI 3.5-19, the staff requested the applicant to verify that the complete scope of the AMP, as described in NUREG-1801, GALL Volume 2, is being credited to manage aging effects for license renewal. If this is not the case, the applicant was requested to identify and document the justification for each exception. In response to RAI 3.5-19, the applicant stated the following:

> As stated in the Application, VCSNS maintains a Tendon Surveillance Program (B.3.3), which is consistent with GALL X.S1, XI.S2, and 10 CFR 50.55a.
>
> VCSNS does not believe that there are any further changes required for the Application Appendix A, since only summary statements are recommended by NEI 95-10. Commitment to all Regulations and Regulatory Guides are implicit in the development of each of these programs as described in Section 7 of TR00170-003.

In LRA Section B.3.3, the applicant stated that a review of the non-conformances written to address programmatic and problematic deficiencies with the Tendon Surveillance Program indicates that there have been no adverse trends associated with aging that are not inherent to this type of post-tensioning system.

The applicant states that a nonconformance was identified to address the collection of water due to in-leakage into the auxiliary building tendon sump area to a depth that submerged a tendon end cap. The water level in the pit was reduced to a level below the tendon end cap. During RF-12 the tendon end cap was removed for inspection and no free water was found. Grease samples (analyzed for entrained moisture) and the tendon components (inspected for corrosion) were found to be acceptable. As a corrective action, operations added the auxiliary building tendon sump area to their trend logs and will request facilities to drain the area if the water level in the area approaches the level of the tendon end cover.

The staff has concerns about the long-term condition of the tendon anchorages if subjected to additional episodes of water infiltration. Such environments could potentially degrade the tendon anchorage system, including anchor components inside the end cap, the baseplate, and reinforced concrete region around the anchors. In RAI 3.5-27, the staff requested the applicant to (1) explain the relationship between the auxiliary building tendon sump area and the tendon access gallery beneath the containment, (2) identify the type of tendon end caps (horizontal, vertical) in the auxiliary building tendon sump area, (3) describe the plant-specific operating experience related to leakage and/or flooding in the tendon access gallery, and identify whether the tendon access gallery is also included in the operations “trend logs” to prevent excessive water level, (4) indicate whether draining of the auxiliary building tendon sump area is credited for management of aging of the tendon prestressing system, and (5) discuss why water is allowed to remain in the auxiliary building tendon sump area and only drained if the water level in the area approaches the level of the tendon end cover. In response to RAI 3.5-27, the applicant stated the following:

> 1) The Tendon Access Gallery (TAG) runs 360° beneath the circular containment wall and only houses the vertical tendon lower end caps. There is no structural connection of the TAG with the Auxiliary Building. The VCSNS containment structure is designed with vertical, horizontal (hoop) and dome tendons, using a three-buttress system (spaced at 120°) to anchor the horizontal tendons. One containment concrete buttress (308° azimuth) is located adjacent to (and within) the Auxiliary Building, which extends into a lower pit area (providing access to the lower horizontal tendon end caps).
>
> 2) As noted in Response 1), only horizontal tendon end caps are located within the Auxiliary Building sump area.
>
> 3) There is no operating experience at VCSNS concerning flooding in the TAG. The TAG has experienced continuing (since construction) groundwater in-leakage via cracks and construction joints along the outer wall; however, this leakage is a very slow infiltration, which is easily accommodated by the sumps and drains. [The TAG is a totally separate area within the plant and has drains, sumps and pumps to maintain the area relatively dry.] The TAG has no operating experience of any significant water accumulation; therefore, Operations trend logs are not required to prevent excessive water level accumulation.

4) Only one horizontal tendon (at the bottom of the 308° buttress) has been subjected to standing water; therefore, the commitment for Operations to monitor this area has not been credited for managing aging of the tendon prestressing system. Aging management will continue to be controlled via the Tendon Surveillance Program.

5) This lower area at the 308° buttress was not originally intended to be a sump, but rather a recessed area for access to the horizontal tendons, and does not have a drainage system installed (which would now be extremely costly to install); therefore, monitoring and pumping are significantly more cost effective. The Tendon Surveillance Program manages this particular problem without the cost of a plant modification.

The applicant's response to RAI 3.5-27, resolves the staff's concern about the AMP for the tendon anchorages, since there has been no operating experience of any significant water accumulation in the tendon access gallery of the containment. Based on current operating experience, the staff accepts the applicant's commitment for VCSNS operations to monitor the auxiliary building sump area and to drain the area if the water level in the area approaches the level of the tendon end cover.

Conclusions

On the basis of its review and audit of the applicant's program, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. Since the GALL program is acceptable to the staff, the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the FSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.5.2.4 Aging Management Review of Plant-Specific Structures and Structural Components

In this section of the SER, the staff presents its review of the applicant's AMR for specific structural components. To perform its evaluation, the staff reviewed the components listed in LRA Tables 2.4-1 through 2.4-14. The staff also reviewed Report TR00170-003, Revision 0, Attachment II: Aging Management Review Results for Structures and Structural Components. Attachment II contains 10-column formatted tables that identify each structural component type, its intended function(s), material, environment, aging effect(s), AMP(s), consistency with the NUREG-1801 AMP(s), and applicable notes. The staff determined whether the applicant properly identified the applicable aging effects and AMPs needed to adequately manage these aging effects. This element of the staff's review involved identification of the aging effects for each component, and ensuring that the AMR for each component is appropriately identified in the LRA Section 3 tables, and that an appropriate AMP is credited for management of the aging effect. The results of the staff's review are provided below.

The staff notes that the applicant did not create separate commodity groups (e.g., component supports) for structural components common to most buildings/structures. Instead, component supports and other common structural components are repeated under each building/structure in Report TR00170-003, Revision 0, Attachment II.

3.5.2.4.1 Reactor Building (Structure and Foundation, Containment Liner, Penetrations)

Summary of Technical Information in the Application

In the VCSNS LRA, the reactor building includes not only the containment structure and foundation, containment liner, and penetrations, but also the containment internal structures. In GALL, containment internal structures are included with Class I structures in Chapter III because they are similar with respect to the aging management issues and credited programs. To minimize repetition, the staff evaluation of the AMR for containment internal structures is included in Section 3.5.2.4.2, "Other Building Structures." This section of the SER only addresses the structural components of the containment pressure boundary.

LRA Section 2.4.1 provides a description of the VCSNS reactor building. The containment is a prestressed concrete cylindrical structure with a domed roof and a carbon steel liner plate on the inside surface. Vertical, hoop and dome tendons are used to precompress the concrete walls and dome. The AMR results for the containment structure are presented in LRA Table 3.5-1, AMR Items 1 through 15. Detailed documentation of the applicant's AMR for the reactor building is contained in Report TR00170-003, Revision 0, Attachment II, pages 37 through 46.

The materials of construction for the containment structure are carbon steel, stainless steel, concrete, and elastomers. These materials are exposed to one or more of the following environments — reactor building, indoor, outdoor, borated water, below-grade.

Aging Effects:

Report TR00170-003, Revision 0, Attachment II identifies the following aging effects for the containment structure:

- cracking, loss of material, and change in material properties for concrete components
- cumulative fatigue, cracking, and loss of material for steel containment penetrations
- loss of material for carbon steel components
- loss of prestress and loss of material for containment tendons
- cracking and change in material properties for elastomers

Aging Management Programs:

Report TR00170-003, Revision 0, Attachment II credits the following AMPs with managing the identified aging effects for the containment structure:

- Containment ISI Program — IWE/IWL
- 10 CFR 50 Appendix J Leak Rate Testing Program
- Maintenance Rule Structures Program
- Boric Acid Corrosion Surveillances Program
- Containment Coating Monitoring and Maintenance Program
- Tendon Surveillance Program

A description of these AMPs is provided in LRA Appendix B. The applicant concluded that the effects of aging associated with the components in the containment structure will be adequately managed by these AMPs such that there is reasonable assurance that the intended functions will be maintained consistent with the CLB during the period of extended operation.

Staff Evaluation

The staff reviewed the information in Sections 2.4 and 3.5 of the LRA; Report TR00170-003, Revision 0, Attachment II; the applicant's responses to the staff's RAIs; and the applicable AMP descriptions in Appendix B of the LRA, to determine whether the applicant has demonstrated that the aging effects associated with the components of the containment will be adequately managed during the period of extended operation.

In the initial review of the applicant's AMR for the containment structure, the staff identified several issues in need of resolution.

AMR items 7 and 15 of LRA Table 3.5-1 indicate that for the concrete containment structure only certain aging effects require aging management. As an example, for accessible exterior concrete, only change in material properties due to leaching is identified as requiring aging management. It is the staff position that ASME Section XI, Subsection IWL should be credited for managing loss of material, cracking, and change in material properties for the concrete containment structure; and that inaccessible concrete (i.e., below grade) also requires aging management unless specific criteria defined in NUREG-1801 GALL Volume 2 are satisfied, to demonstrate a nonaggressive below-grade environment.

In RAI 3.5-2, parts (a), (c), (d), and (e), the staff requested the applicant to provide the following additional information related to aging management of the containment concrete:

1. Verify that cracking, loss of material, and change in material properties will be managed in accordance with NUREG-1801, XI.S2, ASME XI, Subsection IWL for all accessible containment concrete components.

2. Submit a quantitative assessment of the below-grade environment, comparing it to the specific criteria defined in GALL Volume 2.

3. If it is nonaggressive, based on satisfaction of the specific criteria defined in GALL Volume 2, describe the Ground Water Monitoring Program that will be implemented to verify that the below-grade environment remains non-aggressive, including monitoring frequency and consideration of seasonal fluctuations.

4. If the below-grade environment does not satisfy the specific criteria defined in GALL Volume 2, describe in detail the plant-specific AMPs for inaccessible concrete components.

In its response to RAI 3.5-2, parts (a), (c), (d), and (e), the applicant stated the following:

> Application Section 2.1.2.2.3 states: " For concrete structures and structural components, VCSNS has used the Part 54 Process, NUREG-1801, and industry guidelines to determine those specific aging effects that are applicable and require aging management for the Extended Period of Operation (EPO). Recent positions by the NRC Staff have determined that all aging effects for concrete are credible and should be managed under the CLB programs for the EPO." -- The issue of managing all versus specific concrete aging effects for accessible areas is actually a moot point since the plant AMPs (Maintenance Rule Structures Program and Containment ISI Program - IWE/IWL) look for any concrete degradation, regardless of mechanism or effect. Therefore, the VCSNS AMPs are considered acceptable to evaluate aging of concrete elements of the Containment and other Class 1 Structures (which is the intent of the NRC Staff position).

The three steel component types identified in Attachment II of TR00170-003 [anchorage, anchorage/embedments (exposed surfaces), and embedments] are only related to aging effects for steel, and not for concrete. All accessible concrete (including that surrounding the steel anchorages and embedments) is accounted for under component type “Reinforced Concrete - Beams, Columns, Floor Slabs, Walls” which is managed under the Maintenance Rule Structures Program and Containment ISI Program - IWE/IWL.

(a) Concrete aging effects (cracking, loss of material, and change in material properties) will be managed at VCSNS in accordance with NUREG-1801, XI.S2, ASME XI, Subsection IWL (Application Section B.1.16) for all accessible containment concrete components.

(b) Section 6.1 (Table 6.1-3) of TR00170-003 provides the quantitative assessment of the below-grade groundwater environment at VCSNS. These analyses results are based on samples taken in 2001 from three (3) wells in the general vicinity of plant structures. [Note that prior sample analyses for chlorides, sulfates and pH do not exist.] Groundwater chlorides (from all three wells) were determined to be < 10 ppm, which is well within the GALL defined limits of < 500 ppm. Groundwater sulfates (from all three wells) were determined to be < 10 ppm, which is well within the GALL defined limits of < 1500 ppm. Groundwater pH (from the three wells) was determined to range from 4.8 to 5.3, which marginally exceeds the GALL defined limits of 5.5. Based on these results, the VCSNS Application defines the site groundwater as non-aggressive, although mildly acidic.

[Supplemental response to RAI 3.5-2, part (c)]

The NRC Staff position is that the VCSNS groundwater is considered to be aggressive since it has a pH < 5.5. In order to satisfy this concern, the following provisions will be incorporated as part of existing plant programs and procedures:

1) The site excavation and backfill procedure will be revised to include a concrete surface inspection by engineering personnel if soil is removed adjacent to any concrete structure surfaces at or below the nominal groundwater elevation of 423’.

2) As noted in response to RAI 3.5-2(d), chemical analysis of groundwater will be conducted on a 5-year interval to coincide with the Maintenance Rule Structures Inspection Program. This analysis will also include a water sample from the Service Water Pond.

3) Underwater diver’s inspections of the Service Water Intake Structure (tunnel) will continue as described in response to RAI 3.5-26. These inspections will provide additional assurance of the integrity of concrete structures exposed to below water conditions.

[End of supplemental response]

(d) Application Table 3.5-1, Item 17. specifies that periodic monitoring of the below grade water chemistry will be conducted during the period of extended operation to demonstrate that the below-grade environment is not aggressive. VCSNS Engineering Services Procedure (Inspections for Maintenance Rule - Structures) will be revised to include a chemical analysis of raw water (including groundwater) on a 5-year interval to coincide with the Maintenance Rule Structures Inspections. [Note that seasonal fluctuations are not applicable at VCSNS since the level of groundwater remains relatively constant due to the influence of Monticello Reservoir.]

(e) Application Table 3.5-1, Items 7 and 16, discusses aging mechanisms and effects for inaccessible concrete. Since the VCSNS below grade environment marginally exceeds the specific pH criteria defined in GALL, the concrete design was further reviewed and determined to provide protection against aggressive chemical attack. Since the below-grade structures are considered to be resistant to the mildly acidic environment, plant specific aging management programs are not required for inaccessible concrete areas.

The staff finds the applicant’s response to RAI 3.5-2, pertaining to aging management of concrete for the containment structure, to be acceptable because the applicant committed to manage aging of accessible concrete under its IWL program, and also committed in its

supplemental response to part (c) of the RAI to a plant-specific program to manage aging of inaccessible concrete. This is consistent with GALL.

Report TR00170-003, Revision 0, Attachment II does not list O-rings for the containment airlocks and hatch or seals for fire/flood doors as separate components. Therefore, there is no documented AMR. Since these components are passive and are typically replaced only upon identification of a degraded condition, they require an AMR. In RAI 3.5-3, the staff requested the applicant to submit its AMR for these components, including a description of the aging management programs that will be relied upon to ensure there is no loss of intended function during the period of extended operation.

In its response to RAI 3.5-3, the applicant stated the following:

> 1) O-rings for the Containment equipment, personnel and escape hatches are generically included with Reactor Building Component Type "Compressible Joints and Seals" (Elastomers) in Attachment II of TR00170-003. The O-rings are inspected during each refueling outage for repair, replacement and/or lubrication, and subsequently tested under 10CFR50 Appendix J (Leak Rate Testing) as discussed in Appendix B.1.12 of the Application.
>
> 2) Fire/flood/pressure door seals or gaskets are subcomponents of the door and are not explicitly called out in scoping and screening, similar to mounting hardware (threshold, latches, strike plates, hinges, sills, etc.). Door gaskets are extruded closed cell sponge type, made of neoprene rubber or equal and conform to ASTM D1056, Grade 2C1 (VCSNS Specification SP-631). As evaluated in TR00170-003 Section 6.6, neoprene rubber's resistance to oils, chemical, sunlight, weathering, aging, and ozone is outstanding. It retains its properties at temperatures up to 250^{o} F. No aging effects are expected. Although door gaskets were treated as subcomponents, fire/flood/pressure doors are managed under the Maintenance Rule Structures Program and Fire Protection Program as identified in Attachment II of TR00170-003. Detailed discussion on fire/flood/pressure doors is contained in Sections 7.10.2, 7.11, and 7.14 of TR00170-003.

The staff finds the applicant's response to RAI 3.5-3, to be acceptable, when considered together with the applicant's response to RAI 3.5-5, pertaining to technical specification 3/4.6.1. The applicant's approach to managing aging of the containment personnel airlocks and equipment hatch is consistent with GALL.

In the "Aging Management Programs" column of the Report TR00170-003, Revision 0, Attachment II Table, technical specification 3/4.6.1 is listed for the following component types in the reactor building — personnel airlock, escape hatch, and equipment hatch. In the first part of RAI 3.5-5, the staff requested the applicant to describe the objective, scope, and implementation procedures for this technical specification, as it relates to aging management for license renewal.

In the first part of its response to RAI 3.5-5, the applicant stated the following:

> 1) Attachment II (Reactor Building) of TR00170-003 lists Technical Specification 3/4.6.1 under AMPs for personnel airlock, escape airlock, and equipment hatch. This Technical Specification covers Limiting Conditions of Operation for Containment Air Locks, requiring periodic (6 month) tests of leakage rates. Verification of leakage rates ensures functional integrity, thereby supplementing inspections conducted under the Containment ISI Program - IWE/IWL and 10 CFR 50 Appendix J Leak Rate Testing. Type B LLRTs for the primary containment hatches are performed in accordance with plant procedures as identified in Section 7.2 of TR00170-003.

The staff finds the applicant's response to RAI 3.5-5, to be acceptable, when considered together with the applicant's response to RAI 3.5-3, pertaining to the containment airlocks and

equipment hatch. The applicant's approach to managing aging of the containment personnel airlocks and equipment hatch is consistent with GALL.

LRA Section 3.5.1.1 indicates that the reactor building foundation mat bears on fill concrete that extends to competent rock, and that a retaining wall, extending approximately one-quarter of the way around the reactor building, protects the below-grade portions of the reactor building wall from the subgrade. LRA Section 2.4.1 further indicates that the retaining wall protects the below-grade portions of the reactor building wall from the subgrade and groundwater. The groundwater at VCSNS has been identified as being mildly acidic but considered nonaggressive in LRA Table 3.5-1. It is not clear to the staff whether the retaining wall serves an intended function and is subject to an AMR.

In RAI 3.5-10, the staff requested the applicant to submit the following information related to the retaining wall:

3. Describe in detail the primary function(s) for the retaining wall.

4. Discuss the consequences of its failure on structures and components that serve intended functions.

5. If the retaining wall serves an intended function, submit the aging management review for the retaining wall, including the aging management programs credited to manage aging.

6. Otherwise, submit the technical basis for concluding that the retaining wall serves no intended function.

In its response to RAI 3.5-10, the applicant stated the following:

> (a) The retaining wall exists along the northeast quadrant of containment (between the Intermediate and Fuel Handling Buildings) and separates the below grade portions of the containment wall from the subgrade. The design function of this wall is to provide accessibility to the exterior concrete surface of the containment structure (above the structural foundation level), primarily for access to the horizontal tendon buttress end caps.
>
> (b) Hypothetical failure of the retaining wall onto the containment wall and/or horizontal tendon end caps would not result in any failures of the safety-related structures or components. The consequences of such failure would be primarily economical for repair and replacement.
>
> (c) There are no intended functions for the retaining wall as defined for license renewal. It is not intended to provide shelter or protection, structural or functional support, or flood protection for safety-related equipment. Therefore, aging management and aging management programs are not required.

The staff finds the applicant's response to RAI 3.5-10 to be acceptable on the basis that the applicant considered intended functions for the retaining wall and adequately justified that it does not serve any intended function for the purpose of license renewal.

LRA Table 2.4-2 indicates that the AMR results for numerous component types in the reactor building (such as containment liner plate, cable tray, conduit, electrical and instrument panels and enclosures, fire doors, flood curbs, and HVAC duct supports) are presented in LRA Table 3.5-1, AMR Item 13. LRA Table 3.5-1, AMR Item 13 covers the component group, "Steel

elements; protected by coating," and lists four AMPs in the "Discussion" column. These are 10 CFR Part 50 Appendix J General Visual Inspection; Containment Coating Monitoring and Maintenance Program; Containment ISI Program — IWE/IWL; and Maintenance Rule Structures Program. Report TR00170-003, Revision 0, Attachment II only credits the Coating Monitoring and Maintenance Program for aging management of the containment liner plate. It is not apparent to the staff which AMPs are being credited for which components.

In RAI 3.5-14, the staff requested the applicant to clarify the following items:

(1) Table 3.5-1, AMR Item 13 covers the component group, "Steel elements; protected by coating." Are all components that reference AMR Item 13 protected by coatings, and are the coatings managed by a Coating Monitoring and Maintenance Program?

(2) For each of the component types covered under AMR item 13, identify which of the four AMPs are credited for license renewal.

In its response to RAI 3.5-14, the applicant stated the following:

> (a) Application Table 3.5-1, Item 13, includes all steel component types inside containment since this is the only GALL item identified for this component category. In general, all of these components are covered by all of the AMPs. The 10 CFR 50 Appendix J General Visual Inspection, Containment ISI Program - IWE/IWL, and Maintenance Rule Structures Program all look for component degradation, and since most steel components are painted, degradation of their protective coating provides an initial indication for more detailed inspections. The Containment Coating Monitoring and Maintenance Program looks for coating degradation throughout (regardless of specific component) and is therefore a subset of the other AMPs.
>
> (b) The four (4) listed AMPs apply to all components in Application Table 3.5-1 (Item 13). AMPs are generic programs that look for all types of degradation throughout and do not list individual components on a specific checklist for a specific program.

The staff finds the applicant’s response to RAI 3.5-14 to be acceptable. This SRP-LR Table 3.5-1 entry was intended to be more restrictive than the applicant’s interpretation. The applicant’s response provided the necessary clarification.

For the containment post-tensioning system, Report TR00170-003, Revision 0, Attachment II, identifies loss of material and loss of prestress as the aging effects requiring management, and the Tendon Surveillance Program as the applicable AMP. The match with GALL is specified as “partial” However, LRA Table 3.5-1, AMR Items 14 and 11, respectively address the same aging effects for the post-tensioning system, and identify the Containment ISI Program — IWE/IWL and the Tendon Surveillance Program as the applicable AMPs. Both AMPs are identified as consistent with GALL. In RAI 3.5-15, in order to clarify this apparent contradiction, the staff requested the applicant to explain what is meant by a partial match in Report TR00170-003, Revision 0, Attachment II, and to submit the technical basis for any deviations from the GALL programs that manage aging of the post-tensioning system (i.e., GALL XI.S2 and X.S1).

In its response to RAI 3.5-15, the applicant stated the following:

> 1) VCSNS based its original Tendon Surveillance Program on proposed Revision 3 of Reg. Guide 1.35 dated April 1979, although it was in a "proposed" status. The Guide remained in this status until July 1990 when the finalized Revision 3 was issued. However, on April 28, 1989, the NRC accepted the VCSNS Tendon

Surveillance Program based on the proposed Revision 3 of Regulatory Guide 1.35. In March 1995, the NRC issued a new rule, 10 CFR 50.55a, which invoked the requirements of the ASME Code, Section XI, Subsections IWE and IWL, 1992 Edition and 1992 Addenda. The Reactor Building tendon prestress is monitored and programmatically controlled under plant procedures and specifications as discussed in Section 7.17 of TR00170-003.

2) The "partial" match was selected in Report TR00170-003 due to the fact that the GALL credits the 1992 Edition with the 1992 Addenda and the 1995 Edition with the 1996 Addenda of ASME Code Section XI, Subsection IWL for managing containment post-tensioning system. Whereas, the VCSNS Tendon Surveillance Program was developed in accordance with the requirements of the 1992 Edition with the 1992 Addenda.

The staff finds the applicant's response to RAI 3.5-15 to be acceptable because GALL credits either the 1992 Edition with the 1992 Addenda or the 1995 Edition with the 1996 Addenda of ASME Code Section XI, Subsection IWL. Since the applicant's program was developed in accordance with the requirements of the 1992 Edition with the 1992 Addenda, it is consistent with GALL.

For the personnel airlock, escape airlock, and equipment hatch, the staff considers that loss of leak tightness in a closed position due to mechanical wear of locks, hinges, and closure mechanisms is an applicable aging effect that needs to be managed. This is NUREG-1801, Volume 2, and GALL Item Number II.A3.2-b. From the information provided on page 43 of Report TR00170-003, Revision 0, Attachment II, it is not clear whether this aging effect will be managed for license renewal. LRA Table 3.5-1, AMR item 5 indicates an apparent commitment to manage this aging effect. However, the following statement is included in the "Discussion" column — "Operation of hatches is governed by VCSNS Technical Specifications. Plant operational experience has not identified any fretting or seal degradation. Locks, hinges, and closure mechanisms are active components; therefore, mechanical wear is not considered an aging effect."

In RAI 3.5-17, the staff requested the applicant to provide the following clarifications:

1. Verify that loss of leak tightness in a closed position, resulting from mechanical wear of locks, hinges, and closure mechanisms, is an applicable aging effect requiring management for the containment personnel airlock, escape airlock, and equipment hatch.

2. Identify the aging management programs that are credited to manage this aging effect.

3. Indicate whether technical specification 3/4.6.1, which is referenced as an aging management program for the personnel airlock, escape airlock, and equipment hatch in Report TR00170-003, Revision 0, Attachment II, allows any deviations from the requirements specified in GALL XI.S1, ASME Section XI, Subsection IWE. If so, describe the deviations and provide the technical basis for concluding that the aging management commitment is at least equal to the ASME Section XI, Subsection IWE aging management program.

In its response to RAI 3.5-17, the applicant stated the following:

(a) As stated in Application Table 3.5-1, Item 5, VCSNS does not consider mechanical wear as an applicable aging effect since locks, hinges and closure mechanisms are active components. However, leak tightness of the airlocks and hatches (in the closed position) will be managed for License Renewal for the extended period of operation via inspections conducted under maintenance surveillance activities, Containment ISI Program IWE/IWL, 10 CFR 50 Appendix J General Visual Inspection, 10 CFR 50 Appendix J Leak Rate Testing and Technical Specification 3/4.6.1 requirements.

(b) Technical Specification 3/4.6.1 does not allow any deviations from the requirements of the Containment ISI Program - IWE/IWL. It conservatively supplements the requirements for operability.

The staff finds the applicant's response to RAI 3.5-17 to be acceptable because the applicant has clarified that its program to ensure leak tightness of the containment airlocks and hatch in the closed position is consistent with GALL.

The detailed staff reviews of the Maintenance Rule Structures Program, the Containment ISI Program — IWE/IWL, the 10 CFR Part 50 Appendix J Leak Rate Testing Program, the Boric Acid Corrosion Surveillances Program, the Containment Coating Monitoring and Maintenance Program, and the Tendon Surveillance Program are in Sections 3.0.3.4, 3.5.2.3.6, 3.5.2.3.2, 3.0.3.1, 3.5.2.3.5, and 3.5.2.3.12 of this SER, respectively.

Based on the applicant's additional commitments to manage aging consistent with GALL, as identified in the applicant's responses to the RAIs, and review of the credited AMPs, the staff finds the applicant's AMR for the containment structure to be acceptable.

The aging effects identified for the reactor building (structure and foundation, containment liner, penetrations) are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified. On the basis of its review, the staff finds that the AMPs credited in the LRA for the reactor building (structure and foundation, containment liner, penetrations) will effectively manage or monitor the aging effects identified in the LRA.

Conclusions

On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.4.2 Other Building Structures (Auxiliary Building, Control Building, Diesel Generator Building, Fuel Handling Building, Intermediate Building, Turbine Building, Containment Internal Structures)

Summary of Technical Information in the Application

The applicant presented its AMR results for building structures other than containment, and for structural components within the building structures, in LRA Table 3.5-1, AMR items 16 through 29 and LRA Table 3.3-1, AMR Items 9, 12, and 19. Plant-specific AMRs are presented in LRA Table 3.5-2, AMR Items 1 through 6. Detailed documentation of the applicant's AMR for

building structures and structural components is contained in Report TR00170-003, Revision 0, Attachment II, pages 2 through 51.

The staff notes that Report TR00170-003, Revision 0, Attachment II, page 34, identifies “Neutron absorbing sheets - Boraflex” and a ‘Boraflex Monitoring Program.” However, in the “Notes” column, the applicant indicates that Boraflex will be replaced with Boral. The applicant’s AMR for Boral is presented in LRA Table 3.3-1, AMR Items 9 and 12; the applicant did not identify any aging effects requiring management for license renewal,

A brief description of the other building structures is provided in LRA Section 2.4.2, “Other Structures.” The materials of construction for the building structures and structural components are carbon steel, stainless steel, concrete, elastomers, masonry block, drywall, Boral, and styrofoam. These materials are exposed to one or more of the following environments — outdoor, indoor, borated water, below-grade.

Aging Effects:

Report TR00170-003, Revision 0, Attachment II identifies the following applicable aging effects for other building structures and structural components:

- loss of material and MIC for carbon steel components
- change in material properties, cracking, and loss of material for concrete components
- cracking of masonry block
- cracking, shrinkage, and change in material properties for elastomers
- cumulative fatigue and cracking for stainless steel components
- degradation of styrofoam and drywall

Aging Management Programs:

Report TR00170-003, Revision 0, Attachment II credits the following AMPs with managing the identified aging effects for other building structures and structural components:

- Chemistry Control Program
- Fire Protection Program
- Containment ISI Program — IWE/IWL
- 10 CFR Part 50 Appendix J Leak Rate Testing Program
- Maintenance Rule Structures Program
- Boric Acid Corrosion Surveillances Program
- Battery Rack Inspection Program
- ASME Section XI ISI Program — IWF
- Material Handling Systems Inspection Program

A description of these AMPs is provided in LRA Appendix B. The applicant concluded that the effects of aging associated with other building structures and structural components will be adequately managed by these AMPs such that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

Staff Evaluation

The staff reviewed the information in Sections 2.4, 3.3, and 3.5 of the LRA; Report TR00170-003, Revision 0, Attachment II; the applicant's responses to the staff's RAIs; and the applicable AMP descriptions in Appendix B of the LRA, to determine whether the applicant has demonstrated that the aging effects associated with the other building structures and structural components will be adequately managed during the period of extended operation.

In the initial review of the applicant's AMR for the other building structures and structural components, the staff identified several issues in need of resolution.

In Report TR00170-003, Revision 0, Attachment II: Aging Management Review Results for Structures and Structural Components, cable trays, conduit, and electrical and instrument panels and enclosures are identified as component types within most of the buildings and structures. These components are identified as steel in an internal environment, except for the electrical substation and transformer area, where the environment is external. In all cases, no aging effect requiring aging management is identified.

The staff believes that these components located in the reactor, auxiliary, intermediate, and fuel handling buildings are susceptible to boric acid corrosion and that these components located in an external environment are susceptible to environmental corrosion. Therefore, in both cases loss of material is an applicable aging effect requiring aging management. In RAI 3.5-1, the staff requested the applicant to identify and describe the AMPs, which will manage loss of material for these components located in the reactor, auxiliary, intermediate, and fuel handling buildings, and in an external environment.

In its response to RAI 3.5-1, the applicant stated the following:

> 1) Section 6.2 of TR00170-003 identifies electrical panels, cabinets, cable trays, etc. as being constructed of factory baked painted steel or galvanized sheet metal, both of which do not have a tendency to age with time due to general corrosion. VCSNS realized that these components are designed for outdoor service and industry operating experience has not shown a case where aging effects caused a loss of intended function. Therefore, these components in the Electrical Substation and Transformer Area were judged to have no aging effects from general corrosion due to an external environment.
>
> Even though corrosion is considered unlikely, Attachment II of TR00170-003 will be revised for the external environment to include loss of material (for Cable Tray & Conduit and Electrical and Instrument Panels & Enclosures) as an aging effect which is managed by the Maintenance Rule Structures Program.
>
> 2) The attributes of these materials (factory baked painted steel or galvanized sheet metal) were similarly deemed to provide additional protection from boric acid corrosion and thus judged to have no aging effects. However, Section 7.6 of TR00170-003, "Boric Acid Corrosion Surveillances" (Scope of Program) does include these electrical components under Boric Acid Corrosion Surveillances for managing aging effects (loss of material). Therefore, Attachment II of TR00170-003 will be revised for Reactor, Auxiliary, Intermediate, and Fuel Handling Buildings to include loss of material (for Cable Tray & Conduit and Electrical and Instrument Panels & Enclosures) as an aging effect which is managed by Boric Acid Corrosion Surveillances and Maintenance Rule Structures Program.

The staff finds that the part of the applicant's response to RAI 3.5-1, pertaining to a borated environment, is acceptable because the applicant has committed to manage aging of cable trays, conduit, and electrical and instrument panels and enclosures in a borated water environment as part of the Boric Acid Corrosion Surveillances Program and the Maintenance Rule Structures Program.

Many concrete component types in internal, external, and below-grade environments are identified in Report TR00170-003, Revision 0, Attachment II as having no aging effects requiring aging management. The specific component types are duct banks, equipment pads, flood curbs, foundations, hatches, missile shields, reinforced concrete-beams, columns, floor slabs, walls, roof slabs, sumps, caissons, piers, trenches, jet barriers and manholes. The staff position is that all accessible concrete components that perform intended function require aging management for loss of material, cracking, and change in material properties; and that inaccessible concrete components (i.e., below grade) also require aging management unless specific criteria defined in NUREG-1801 GALL Volume 2 are satisfied, to demonstrate a nonaggressive below-grade environment.

Report TR00170-003, Revision 0, Attachment II also lists three steel components in a concrete environment. These are anchorage, anchorage/embedments (exposed surfaces) and embedments. All are identified as having no aging effects requiring aging management. The condition of the concrete surrounding anchorage and embedments may affect their load capacity. GALL Volume 2, III.B, Item Numbers III.B1.1.4, III.B1.2.3, III.B2.2, III.B3.2, III.B4.3, and III.B5.2 specifically identify the need for aging management of the concrete surrounding expansion and grouted anchors, and grout pads for support base plates. The staff position is that all accessible concrete requires aging management; this includes monitoring the condition of concrete surrounding anchorages and embedments.

AMR Items 7 and 15 of LRA Table 3.5-1 indicate that for the concrete containment structure only certain aging effects require aging management. As an example, for accessible exterior concrete, only change in material properties due to leaching is identified as requiring aging management. It is the staff position that ASME Section XI, Subsection IWL should be credited for managing loss of material, cracking, and change in material properties for the concrete containment structure; and that inaccessible concrete (i.e., below grade) also requires aging management unless specific criteria defined in NUREG-1801 GALL Volume 2 are satisfied, to demonstrate a nonaggressive below-grade environment.

In RAI 3.5-2, the staff requested the applicant to provide the following additional information:

(a) Verify that cracking, loss of material, and change in material properties will be managed in accordance with NUREG-1801, XI.S2, ASME XI, Subsection IWL for all accessible containment concrete components.

(b) Identify the aging management programs that will manage loss of material, cracking, and change in material properties for all other concrete components in accessible areas.

(c) Submit a quantitative assessment of the below-grade environment, comparing it to the specific criteria defined in GALL Volume 2.

(d) If it is nonaggressive, based on satisfaction of the specific criteria defined in GALL Volume 2, describe the Groundwater Monitoring Program that will be implemented to verify that the below-grade environment remains nonaggressive, including monitoring frequency and consideration of seasonal fluctuations.

(e) If the below-grade environment does not satisfy the specific criteria defined in GALL Volume 2, describe in detail the plant-specific aging management programs for inaccessible concrete components.

In its response to RAI 3.5-2, the applicant stated the following:

> Application Section 2.1.2.2.3 states: "For concrete structures and structural components, VCSNS has used the Part 54 Process, NUREG-1801, and industry guidelines to determine those specific aging effects that are applicable and require aging management for the Extended Period of Operation (EPO). Recent positions by the NRC Staff have determined that all aging effects for concrete are credible and should be managed under the CLB programs for the EPO." – The issue of managing all versus specific concrete aging effects for accessible areas is actually a moot point since the plant AMPs (Maintenance Rule Structures Program and Containment ISI Program - IWE/IWL) look for any concrete degradation, regardless of mechanism or effect. Therefore, the VCSNS AMPs are considered acceptable to evaluate aging of concrete elements of the Containment and other Class 1 Structures (which is the intent of the NRC Staff position).
>
> The three steel component types identified in Attachment II of TR00170-003 [anchorage, anchorage/embedments (exposed surfaces), and embedments] are only related to aging effects for steel, and not for concrete. All accessible concrete (including that surrounding the steel anchorages and embedments) is accounted for under component type "Reinforced Concrete - Beams, Columns, Floor Slabs, Walls" which is managed under the Maintenance Rule Structures Program and Containment ISI Program - IWE/IWL.
>
> (a) Concrete aging effects (cracking, loss of material, and change in material properties) will be managed at VCSNS in accordance with NUREG-1801, XI.S2, ASME XI, Subsection IWL (Application Section B.1.16) for all accessible containment concrete components.
>
> (b) Concrete aging effects (cracking, loss of material, and change in material properties) will be managed at VCSNS in accordance with the Maintenance Rule Structures Program (Application Section B.1.18) for all other concrete components in accessible areas.
>
> (c) Section 6.1 (Table 6.1-3) of TR00170-003 provides the quantitative assessment of the below-grade groundwater environment at VCSNS. These analyses results are based on samples taken in 2001 from three (3) wells in the general vicinity of plant structures. [Note that prior sample analyses for chlorides, sulfates and pH do not exist.] Groundwater chlorides (from all three wells) were determined to be < 10 ppm, which is well within the GALL defined limits of < 500 ppm. Groundwater sulfates (from all three wells) were determined to be < 10 ppm, which is well within the GALL defined limits of < 1500 ppm. Groundwater pH (from the three wells) was determined to range from 4.8 to 5.3, which marginally exceeds the GALL defined limits of 5.5. Based on these results, the VCSNS Application defines the site groundwater as non-aggressive, although mildly acidic.
>
> [Supplemental response to RAI 3.5-2, part (c)]
>
> The NRC Staff position is that the VCSNS groundwater is considered to be aggressive since it has a pH < 5.5. In order to satisfy this concern, the following provisions will be incorporated as part of existing plant programs and procedures:
>
> 1) The site excavation and backfill procedure will be revised to include a concrete surface inspection by engineering personnel if soil is removed adjacent to any concrete structure surfaces at or below the nominal groundwater elevation of 423'.
>
> 2) As noted in response to RAI 3.5-2(d), chemical analysis of groundwater will be conducted on a 5-year interval to coincide with the Maintenance Rule Structures Inspection Program. This analysis will also include a water sample from the Service Water Pond.
>
> 3) Underwater diver's inspections of the Service Water Intake Structure (tunnel) will continue as described in response to RAI 3.5-26. These inspections will provide additional assurance of the integrity of concrete structures exposed to below water conditions.

[End of supplemental response]

> (d) Application Table 3.5-1, Item 17. specifies that periodic monitoring of the below grade water chemistry will be conducted during the period of extended operation to demonstrate that the below-grade environment is not aggressive. VCSNS Engineering Services Procedure (Inspections for Maintenance Rule - Structures) will be revised to include a chemical analysis of raw water (including groundwater) on a 5-year interval to coincide with the Maintenance Rule Structures Inspections. [Note that seasonal fluctuations are not applicable at VCSNS since the level of groundwater remains relatively constant due to the influence of Monticello Reservoir.]
>
> (e) Application Table 3.5-1, Items 7 and 16, discusses aging mechanisms and effects for inaccessible concrete. Since the VCSNS below grade environment marginally exceeds the specific pH criteria defined in GALL, the concrete design was further reviewed and determined to provide protection against aggressive chemical attack. Since the below-grade structures are considered to be resistant to the mildly acidic environment, plant specific aging management programs are not required for inaccessible concrete areas.

The staff finds the applicant's response to RAI 3.5-2, pertaining to aging management of concrete in the other building structures and structural components, to be acceptable because the applicant has committed to manage aging of accessible concrete as part its Maintenance Rule Structures Program, and has also committed in its supplemental response to part (c) of the RAI to a plant-specific program to manage aging of inaccessible concrete. This is consistent with GALL.

Report TR00170-003, Revision 0, Attachment II identifies loss of material as the only aging effect requiring aging management for pipe supports located in the auxiliary building, control building, intermediate building, diesel generator building, fuel handling building, reactor building, and service water structures. The ASME Section XI ISI Program — IWF is identified as one of the credited AMPs.

Attachment II indicates that this is a match with GALL. The staff notes that this is not a match with GALL, because GALL Volume 2, III.B, Item Numbers III.B1.1.3 and III.B1.2.2 also identify loss of mechanical function as an aging effect to be managed by IWF. In RAI 3.5-4, the staff requested the applicant to verify (1) that loss of mechanical function is an applicable aging effect for ASME class piping supports, and (2) that IWF is the applicable AMP, or submit a detailed technical basis for excluding this aging effect and clearly identify this as a deviation from GALL.

In its response RAI 3.5-4, the applicant stated the following:

> Attachment II of TR00170-003 (for Component Type - Pipe Supports) refers to Section 6.9 for details on service-induced cracking and loss of mechanical function aging effect. Section 6.9 of TR00170-003 identifies an exception to GALL III.B1.2.2-a, whereby "loss of mechanical function" is not an aging effect, but rather a design issue. However, since the IWF program is capable of determining loss of mechanical function, TR00170-003 will be revised accordingly to:
>
> > 1) Identify loss of mechanical function as an applicable aging effect for ASME class piping supports, and 2) Identify ASME Section XI, Subsection IWF as the applicable aging management program.

The staff finds the applicant's commitment to manage loss of mechanical function as part of its IWF program to be acceptable because it is consistent with GALL.

In the “Aging Management Programs” column of the Report TR00170-003, Revision 0, Attachment II Table, technical specification 3/4.9.10 is listed for the following component types in the fuel handling building — fuel transfer canal liner plate, spent fuel pool liner, and spent fuel storage rack. In the second part of RAI 3.5-5, the staff requested the applicant to describe the objective, scope, and implementation procedures for this technical specification, as it relates to aging management for license renewal.

In the second part of its response to RAI 3.5-5, the applicant stated the following:

> 2) Attachment II (Fuel Handling Building) of TR00170-003 lists Technical Specification 3/4.9.10 under AMPs for fuel transfer canal liner plate, Spent Fuel Pool liner, and spent fuel storage rack. This Technical Specification covers Limiting Conditions for Operation for water level in the Spent Fuel Pool, requiring at least 23 feet of water maintained over the top of irradiated fuel assemblies seated in the storage racks. Verification of the water level in conjunction with the Chemistry Program ensures a constant level in the pool and avoids continuous wetting/drying of steel components, thereby reducing aging effects. [Note that a recent revision to the VCSNS Technical Specifications relocated these requirements to Section 3/4.7.10.]

The staff finds that the applicant’s response to RAI 3.5-5 provides an adequate description of the role of Technical Specification 3/4.9.10 (now 3/4.7.10) in monitoring the water level in the spent fuel pool located in the fuel handling building.

In LRA Table 3.5-1, AMR Item 19, the applicant credits the Chemistry Program (LRA Appendix B.1.4) for aging management of the stainless steel spent fuel pool liner. The staff considers verification of the effectiveness of a chemistry control program to be an integral element of aging management. For the spent fuel pool, this is readily achieved by monitoring an existing plant-specific, spent fuel pool leak detection system or by monitoring the spent fuel pool water level for indications of leakage. In RAI 3.5-7, the staff requested the applicant to describe its plant-specific operating experience concerning leaks in the spent fuel pool, including a description of each occurrence, how it was detected, the determination of root cause, and how it was remedied.

In its response to RAI 3.5-7, the applicant stated the following:

> 1) At VCSNS, there have been no leaks detected from the Spent Fuel Pool, thus, no operating experience.
>
> 2) A complete discussion related to the Chemistry Program controls for the Spent Fuel Pool is contained in Section 7.7 of TR00170-003. Refer also to RAI 3.5-5 response on monitoring Spent Fuel Pool water level.

The staff finds the applicant’s response to RAI 3.5-7 to be acceptable. Monitoring of the spent fuel pool water level has been addressed in the applicant’s response to RAI 3.5-5, discussed above.

The stainless steel spent fuel storage racks are immersed in the spent fuel pool. In the "Aging Management Programs" column of the Report TR00170-003, Revision 0, Attachment II Table for the fuel handling building, the same AMPs are listed for both the spent fuel pool liner and the spent fuel storage racks. Since both are stainless steel and subjected to a borated water environment, the staff’s evaluation of the applicant’s AMR for the spent fuel pool liner also applies to the spent fuel storage racks. The staff notes that in the LRA, for the spent fuel storage racks, the applicant references LRA Table 3.5-1, AMR items 16, 25, and 27. The correct reference is AMR Item 19, in order to be consistent with Report TR00170-003, Revision 0, Attachment II.

LRA Table 3.5-2 is titled “Summary of Aging Management Programs for Station Containment, Other Structures and Component Supports That are Different From or Not Addressed in NUREG-1801 but are Relied on for License Renewal.” Ten AMR items are listed in the table. For each AMR item, the following information is provided in the table — component type, material, environment, aging effect/mechanism, program activity, and discussion.

The staff's review of LRA Table 3.5-2 identified the need for clarification and additional information relating to a number of the AMR items. For all except one of these items, additional pertinent information has either been requested in other RAIs or was located in Attachment II to Report TR001700-003. The exception is LRA Table 3.5-2, AMR Item 4, "Lubrite Plates (Class 1 Pipe Hanger Supports)." It is identified as a lubricant material in an internal environment. No aging effect/mechanism is identified, and consequently no AMP is identified. In the "Discussion" column, the applicant provided a brief summary of its AMR, which concluded that lubrite plates "are not susceptible to aging effects requiring management."

Aging management of lubrite plates for Class 1 piping supports is addressed in NUREG-1801, GALL Volume 2, III.B, Item No. III.B1.1.3. ASME Section XI, Subsection IWF is identified as the applicable AMP. In RAI 3.5-8, the staff requested the applicant to submit a detailed technical basis to support its conclusion that lubrite plates do not require aging management, or to credit its IWF AMP for aging management of lubrite plates, consistent with GALL.

In its response to RAI 3.5-8, the applicant stated the following:

> An extensive review of Class 1, 2, 3 supports at VCSNS discovered only two (2) Class 1 pipe hanger supports (both inside containment) which incorporated small lubrite slide plates (as discussed in Section 6.8 of TR00170-003). TR00170-003 also contains the technical basis supporting our basic conclusion that lubrite plates do not require aging management. However, all Class 1, 2, 3 supports are inspected under the ASME Section XI ISI Program - IWF (Application Section B.1.13), which provides an acceptable aging management program for aging management of lubrite plates, consistent with the GALL.

The staff finds the applicant’s commitment to manage aging of lubrite plates as part of its IWF program to be acceptable because it is consistent with GALL.

LRA Table 3.5-1 is titled "Summary of Aging Management Programs for Station Containment, Other Structures and Component Supports Evaluated in NUREG-1801 that are relied on for License Renewal." Twenty-nine AMR items are listed in the table. For each AMR item, the following information is provided in the table — component group, aging effect/mechanism, aging management program, further evaluation required, and discussion. This table is a reproduction of NUREG-1800 Table 3.5-1, with an added "Discussion" column. LRA Table 3.5-1 does not indicate that the applicant's AMRs are consistent with GALL. In the "Discussion" column, the applicant refers to AMPs that are "consistent with those reviewed and approved in NUREG-1801." For most of the AMR items, the aging management review is not consistent with GALL. The staff's review of LRA Table 3.5-1 identified the need for clarification and additional information relating to many of the AMR items. For many of these items, additional pertinent information has either been requested in other RAIs or was located in Attachment II to Report TR001700-003. As part of RAI 3.5-9, the staff requested the applicant to submit the following additional information or clarifications related to other building structures and structural components:

(c) For AMR Item 16, explain the reference to two AMPs that are only applicable to the containment structure.

(d) For AMR Item 24, explain the following statement in the "Discussion" column, "Note that the combinations of components, materials, and environments identified in NUREG-1801 for Group 8 (Steel Tanks) are not applicable to VCSNS; therefore, aging management is not required." Do any steel tanks have stainless steel liners? If so, how are SCC and crevice corrosion managed?

(e) For AMR Item 25, clarify which listed subcomponents are managed by each of the two referenced AMPs. Also identify which, if any, of the subcomponents do not require aging management, based on the plant-specific AMR.

(f) For AMR item 28, explain why ASME Section XI, Subsection IWF is not credited for aging management of the ASME class supports, consistent with GALL. How are the two referenced AMPs implemented as a substitute for IWF?

In its response to RAI 3.5-9, parts (d) through (g), the applicant stated the following:

> (d) Consistent with GALL, Application Table 3.5-1, Item 16, is applicable to all Class 1 Structures (including containment), except for Group 6 (water-control structures). Regardless of applicability of aging mechanisms, the AMPs identified are used to look for all aging effects. Therefore, as noted in the RAI, the two AMPs (Containment Coating Monitoring and Maintenance Program and Containment ISI Program – IWE/IWL) are both specific to the containment structure. The Maintenance Rule Structures Program is applicable to all Class 1 Structures, including containment.
>
> (e) The basis of the note for steel tanks in Application Table 3.5-1, Item 24, is from a structural perspective for inspections of exterior tank surfaces, foundations, and anchorages. Steel tanks at VCSNS do not have stainless steel liners. However, SCC and crevice corrosion are monitored from a mechanical perspective, with details contained in Application Sections B.2.1 and B.2.11.
>
> (f) For Application Table 3.5-1, Item 25, the Maintenance Rule Structures Program applies to all subcomponents for all structures (including containment), while the 10 CFR 50 Appendix J General Visual Inspection is used only as a supplementary inspection program for containment. As noted in the discussion for Item 25, cracking due to fatigue is not an aging effect requiring management for concrete components.
>
> (g) Application Table 3.5-1, Item 28, should have credited the ASME Section XI ISI Program - IWF (Application Section B.1.13) as the primary AMP for aging management of the ASME Class 1, 2, 3 supports. The IWF AMP is credited in Attachment II of TR00170-003. The other two programs referenced are included as supplementary programs for additional inspections and are not intended as a substitute for IWF.

The staff finds the applicant's clarifications and additional information for parts (d), (f), and (g) to be acceptable because they are consistent with GALL. The applicant's response to part (e) refers to AMPs related to mechanical systems, described in LRA Sections B.2.1 and B.2.11. The results of the staff review of these AMPs are in Sections 3.0.3.5 and 3.0.3.7 of this SER.

In Report TR00170-003, Revision 0, Attachment II, many structural components are identified as not having any applicable aging effects and thereby no AMPs are specified in the "Aging Management Programs" column. Most of these structural components are concrete, which the staff has addressed in RAI 3.5-2. For several stainless steel components in the reactor building (refueling canal liner plate, sump screens, and sumps), a statement in the "Notes" column indicates that although no aging effects have been identified, the Maintenance Rule Structures Program inspects these components. In RAI 3.5-11, the staff requested the applicant to explain

the intent of this statement. Is the Maintenance Rule Structures Program being credited to manage aging of these components for license renewal?

In its response to RAI 3.5-11, the applicant stated the following:

> Attachment II of TR00170-003 notes that there are no aging effects identified for stainless steel in air environment. However, the Maintenance Rule Structures Program does provide a complete walkdown of the interior of containment, focusing primarily on interior structural components (which does include refueling canal, sumps and screens). Therefore, the Maintenance Rule Structures Program is credited for managing aging of these components.

The staff finds the applicant's response to RAI 3.5-11 to be acceptable. Crediting the Maintenance Rule Structures Program to manage aging of these components is consistent with the intent of GALL (i.e., to credit existing programs to the fullest extent).

The applicant has identified that Boral will replace Boraflex as the neutron absorber in the spent fuel storage racks. The applicant references LRA Table 3.3-1, AMR items 9 and 12. In the "Discussion" column of AMR Item 9, the applicant asserts that Boral does not degrade as a result of long-term exposure to radiation, and there are no aging effects applicable to Boral neutron-absorbing sheets in the spent fuel storage racks of VCSNS. The potential aging effects resulting from sustained irradiation of Boral were previously evaluated by the staff (BNL-NUREG-25582, dated January 1979) and determined to be insignificant. Therefore, the staff finds the applicant's AMR conclusions to be acceptable.

The detailed staff reviews of the Maintenance Rule Structures Program, the Fire Protection Program, the Material Handling Systems Inspection Program, the ASME Section XI ISI Program — IWF, the Chemistry Control Program, the Containment ISI Program — IWE/IWL, the 10 CFR Part 50 Appendix J Leak Rate Testing, the Boric Acid Corrosion Surveillances, and the Battery Rack Inspection are in Sections 3.0.3.4, 3.0.3.3, 3.3.2.3.2, 3.5.2.3.3, 3.0.3.2, 3.5.2.3.6, 3.5.2.3.2, 3.0.3.1, and 3.5.2.3.4 of this SER, respectively.

Based on the applicant's additional commitments to manage aging consistent with GALL, as identified in the applicant's responses to the RAIs and review of the credited AMPs, the staff finds the applicant's AMR for the other building structures and structural components to be acceptable.

The aging effects identified in the LRA for the other building structures (auxiliary building, control building, diesel generator building, fuel handling building, intermediate building, turbine building, containment internal structures) are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified. On the basis of its review, the staff finds that the AMPs credited in the LRA for the other building structures (auxiliary building, control building, diesel generator building, fuel handling building, intermediate building, turbine building, containment internal structures) will effectively mange or monitor the aging effects identified in the LRA.

<u>Conclusions</u>

On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent

with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.4.3 Service Water Pump House, Intake and Discharge Structures

Summary of Technical Information in the Application

The applicant presented its AMR results for the service water pump house, intake and discharge structures in LRA Table 3.5-1, AMR Items 18 and 25. Plant-specific AMRs are presented in LRA Table 3.5-2, AMR Items 7 through 9. Detailed documentation of the applicant's AMR for the service water pump house, intake and discharge structures is contained in Report TR00170-003, Revision 0, Attachment II, pages 52 through 57.

A brief description of the service water pump house, intake and discharge structures is provided in LRA Section 2.4.2, "Other Structures." The materials of construction for the service water pump house, intake and discharge structures are carbon steel, concrete, elastomers, drywall, and styrofoam. These materials are exposed to one or more of the following environments — outdoor, indoor, raw water, below-grade.

Aging Effects:

Report TR00170-003, Revision 0, Attachment II identifies the following applicable aging effects for the service water pump house, intake and discharge structures:

- loss of material for carbon steel components
- change in material properties, cracking, and loss of material for concrete components
- cracking, shrinkage, and change in material properties for elastomers
- degradation of styrofoam and drywall
- settlement of concrete

Aging Management Programs:

Report TR00170-003, Revision 0, Attachment II credits the following AMPs with managing the identified aging effects for the service water pump house, intake and discharge structures:

- Fire Protection Program
- Maintenance Rule Structures Program
- ASME Section XI ISI Program — IWF
- Underwater Inspection Program (SWIS and SWPH)
- Service Water Structures Survey Monitoring Program
- Material Handling Systems Inspection Program

A description of these AMPs is provided in LRA Appendix B. The applicant concluded that the effects of aging associated with the service water pump house, intake and discharge structures will be adequately managed by these AMPs such that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

Staff Evaluation

The staff reviewed the information in Sections 2.4 and 3.5 of the LRA; Report TR00170-003, Revision 0, Attachment II; the applicant's responses to the staff's RAIs; and the applicable AMP descriptions in Appendix B of the LRA, to determine whether the applicant has demonstrated that the aging effects associated with the service water pump house, intake and discharge structures will be adequately managed during the period of extended operation.

In the initial review of the applicant's AMR for the service water pump house, intake and discharge structures, the staff determined that the applicant has identified the appropriate material and aging effects, and has credited appropriate AMPs to manage aging, except for the lack of commitment to manage aging of accessible concrete. The applicant's subsequent commitment to credit its Maintenance Rule Structures Program to manage aging of concrete, as documented in Section 3.5.2.4.2.2 of this SER in the discussion of RAI 3.5-2, also applies to the accessible concrete of the service water pump house, intake and discharge structures.

The plant-specific Service Water Structures Survey Monitoring Program is credited for monitoring settlement, and the plant-specific Underwater Inspection Program (SWIS and SWPH) is credited for managing aging of underwater concrete. The detailed staff reviews of the Maintenance Rule Structures Program, the Fire Protection Program, the Material Handling Systems Inspection Program, the ASME Section XI ISI Program — IWF, the Underwater Inspection Program (SWIS and SWPH), and the Service Water Structures Survey Monitoring Program are in Sections 3.0.3.4, 3.0.3.3, 3.3.2.3.2, 3.5.2.3.3, 3.5.2.3.11, and 3.5.2.3.10 of this SER, respectively.

Based on this new commitment to manage aging of accessible concrete and the review of the credited AMPs, the staff finds the applicant's AMR for the service water pump house, intake and discharge structures to be acceptable.

The aging effects identified in the LRA for the service water pump house, intake and discharge structures are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified. On the basis of its review, the staff finds that the AMPs credited for the LRA for the service water pump house, intake and discharge structures will effectively manage or monitor the aging effects identified in the LRA.

Conclusions

On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.4.4 Yard Structures (Condensate Storage Tank Foundation, Fire Service Pumphouse, Electrical Manhole MH-2, Electrical Substation and Transformer Area)

Summary of Technical Information in the Application

The applicant presents its AMR results for yard structures in LRA Table 3.5-1, AMR Items 16 through 25. A plant-specific AMR is presented in LRA Table 3.5-2, AMR Item 1. Detailed

documentation of the applicant's AMR for yard structures is contained in Report TR00170-003, Revision 0, Attachment II, pages 58 through 68.

A brief description of the yard structures is provided in LRA Section 2.4.2, "Other Structures." The materials of construction for the yard structures are carbon steel, galvanized steel, concrete, elastomers, and masonry block/brick. These materials are exposed to one or more of the following environments — outdoor, indoor, below-grade.

Aging Effects:

Report TR00170-003, Revision 0, Attachment II identifies the following applicable aging effects for yard structures:

- loss of material for carbon steel and galvanized steel components
- change in material properties, cracking, and loss of material for concrete components
- cracking of masonry block/brick
- cracking and shrinkage for elastomers

Aging Management Programs:

Report TR00170-003, Revision 0, Attachment II credits the following AMPs with managing the identified aging effects for yard structures:

- Fire Protection Program
- Maintenance Rule Structures Program
- Battery Rack Inspection Program

A description of these AMPs is provided in LRA Appendix B. The applicant concluded that the effects of aging associated with yard structures will be adequately managed by these AMPs such that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

Staff Evaluation

The staff reviewed the information in Sections 2.4 and 3.5 of the LRA; Report TR00170-003, Revision 0, Attachment II; the applicant's responses to the staff's RAIs; and the applicable AMP descriptions in Appendix B of the LRA, to determine whether the applicant has demonstrated that the aging effects associated with the yard structures will be adequately managed during the period of extended operation.

In Report TR00170-003, Revision 0, Attachment II: Aging Management Review Results for Structures and Structural Components, cable trays, conduit, and electrical and instrument panels and enclosures are identified as component types within most of the buildings and structures. These components are identified as steel in an internal environment, except for the electrical substation and transformer area, where the environment is external. In all cases, no aging effect requiring aging management is identified.

The staff believes that these components located in the reactor, auxiliary, intermediate, and fuel handling buildings are susceptible to boric acid corrosion and that these components located in

an external environment are susceptible to environmental corrosion. Therefore, in both cases, loss of material is an applicable aging effect requiring aging management. In RAI 3.5-1, the staff requested the applicant to identify and describe the AMPs, which will manage loss of material for these components located in the reactor, auxiliary, intermediate, and fuel handling buildings, and in an external environment.

In its response to RAI 3.5-1, the applicant stated the following:

> 1) Section 6.2 of TR00170-003 identifies electrical panels, cabinets, cable trays, etc. as being constructed of factory baked painted steel or galvanized sheet metal, both of which do not have a tendency to age with time due to general corrosion. VCSNS realized that these components are designed for outdoor service and industry operating experience has not shown a case where aging effects caused a loss of intended function. Therefore, these components in the Electrical Substation and Transformer Area were judged to have no aging effects from general corrosion due to an external environment.
>
> Even though corrosion is considered unlikely, Attachment II of TR00170-003 will be revised for the external environment to include loss of material (for Cable Tray & Conduit and Electrical and Instrument Panels & Enclosures) as an aging effect which is managed by the Maintenance Rule Structures Program.
>
> 2) The attributes of these materials (factory baked painted steel or galvanized sheet metal) were similarly deemed to provide additional protection from boric acid corrosion and thus judged to have no aging effects. However, Section 7.6 of TR00170-003, "Boric Acid Corrosion Surveillances" (Scope of Program) does include these electrical components under Boric Acid Corrosion Surveillances for managing aging effects (loss of material). Therefore, Attachment II of TR00170-003 will be revised for Reactor, Auxiliary, Intermediate, and Fuel Handling Buildings to include loss of material (for Cable Tray & Conduit and Electrical and Instrument Panels & Enclosures) as an aging effect which is managed by Boric Acid Corrosion Surveillances and Maintenance Rule Structures Program.

The staff finds that the part of the applicant's response to RAI 3.5-1, pertaining to an external environment is acceptable because the applicant has committed to manage aging of cable trays, conduit, and electrical and instrument panels and enclosures in an external environment as part of its Maintenance Rule Structures Program.

The applicant's commitment to credit its Maintenance Rule Structures Program to manage aging of concrete, as documented in Section 3.5.2.4.2 of this SER in the discussion of RAI 3.5-2, also applies to the concrete foundations of the yard structures.

The detailed staff reviews of the Maintenance Rule Structures Program, the Fire Protection Program, and the Battery Rack Inspection are in Sections 3.0.3.4, 3.0.3.3, and 3.5.2.3.4 of this SER, respectively.

Based on these new commitments and review of the credited AMPs, the staff finds the applicant's AMR for yard structures to be acceptable.

The aging effects identified in the LRA for yard structures (condensate storage tank foundation, fire service pumphouse, electrical manhole MH-2, electrical substation and transformer area) are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified. On the basis of its review, the staff finds that the AMPs credited in the LRA for the yard structures will effectively manage or monitor the aging effects identified in the LRA.

Conclusions

On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.4.5 Earthen Embankments

Summary of Technical Information in the Application

The applicant presented its AMR results for earthen embankments in LRA Table 3.5-1, AMR Item 18. The plant-specific AMR is presented in LRA Table 3.5-2, AMR Item 10. Detailed documentation of the applicant's AMR for earthen embankments is contained in Report TR00170-003, Revision 0, Attachment II, page 69.

A brief description of the earthen embankments is provided in LRA Section 2.4.2, "Other Structures." The material is identified as "earthen" and the environments are raw water, below-grade and external.

Aging Effects:

Report TR00170-003, Revision 0, Attachment II identifies the following applicable aging effects for earthen embankments:

- loss of material/erosion
- cracking/settlement

Aging Management Programs:

Report TR00170-003, Revision 0, Attachment II credits the following AMPs with managing the identified aging effects for earthen embankments:

- Maintenance Rule Structures Program

- Service Water Pond Dam Inspection Program (North Dam, South Dam, East Dam, and West Embankment)

A description of these AMPs is provided in LRA Appendix B. The applicant concluded that the effects of aging associated with earthen embankments will be adequately managed by these AMPs such that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

Staff Evaluation

The staff reviewed the information in Sections 2.4 and 3.5 of the LRA; Report TR00170-003, Revision 0, Attachment II; and the applicable AMP descriptions in Appendix B of the LRA, to determine whether the applicant has demonstrated that the aging effects associated with earthen embankments will be adequately managed during the period of extended operation.

In the initial review of the applicant's AMR for earthen embankments, the staff determined that the applicant has identified the appropriate material and aging effects, and has credited appropriate AMPs to manage aging. The staff did not issue any RAIs related to earthen embankments. The detailed staff review of the Maintenance Rule Structures Program is in Section 3.0.3.4 of this SER. The detailed staff review of the Service Water Pond Dam Inspection Program is in Section 3.5.2.3.9 of this SER.

The aging effects identified in the LRA for the earthen embankments are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified. On the basis of its review, the staff finds that the AMPs credited in the LRA for the earthen embankments will effectively manage or monitor the aging effects identified in the LRA.

Conclusions

On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.6 Electrical and Instrumentation and Controls

The applicant described its AMR of electrical and instrumentation and controls components requiring AMR in Section 3.6 of the LRA. The staff reviewed this section of the application to determine whether the applicant has demonstrated that the effect of aging on the electrical and instrumentation and controls components will be adequately managed during the period of extended operation, as required by 10 CFR 54.2(a)(3).

3.6.1 Summary of Technical Information in the Application

The applicant has performed an AMR on the following electrical and I&C commodity groups:

- non-EQ insulated cables
- non-EQ connectors
- non-EQ spices
- non-EQ electrical penetration assemblies
- non-EQ terminal blocks
- high voltage electrical switchyard bus
- high voltage transmission conductors and connections
- high voltage insulators

The AMR methodology for the electrical discipline for VCSNS is summarized in the following points:

- evaluation of the electrical component commodity groups (subject to AMR) to identify the organic materials subject to age-related degradation

- identification and evaluation of the 60-year service-limiting environmental parameters for these organic materials

- identification and evaluation of the aging mechanisms and effects to determine which require review

- identification and evaluation of the service conditions (i.e., the operating environments and locations) for the electrical component commodity groups

- evaluation of the industry and plant-specific operating experience for the electrical component commodity groups

- aging management program evaluation (following NUREG-1801)

- demonstration of aging management

The review of the VCSNS electrical component commodity groups with respect to aging mechanisms and effects was performed based upon the guidance of various industry documents, primarily SAND 96-0344, "Aging Management Guideline for Commercial Nuclear Power Plants — Electrical Cable and Terminations." This document provides detailed materials analysis for cable and termination materials exposed to nuclear power plant environments. It also provides guidance for performing AMRs pursuant to 10 CFR Part 54.

The methodology used for the AMR of the electrical commodity groups employs the "Plant Spaces" approach in which the plant is segregated into areas (or spaces) where common bounding environmental parameters can be assigned. The VCSNS plant operating environments are delineated as "Environmental Zones." Each bounding environmental zone is evaluated against the material of the commodity groups most susceptible to aging to determine if the components will be able to maintain their intended function through the period of extended operation. With respect to the electrical components, the environmental parameters of interest are temperature, radiation, and moisture.

The intended functions of the electrical component commodity groups under review are as follows:

– to electrically connect or insulate two sections of an electrical circuit and/or to provide for continuity or insulation of electrical circuits

- to provide a leak-tight barrier for containment isolation (this is evaluated in Section 2.4.1.3 of the LRA)

The applicant's AMRs included an evaluation of plant-specific and industry operating experience. The plant-specific evaluation included reviews of condition reports and discussions with appropriate site personnel to identify aging effects that require management. These reviews concluded that no additional aging effects requiring management were identified beyond those identified using the methods described in Section 3.6.2.1 of the LRA.

The applicant's review of industry operating experience included an evaluation of industry operating experience since the publication of NUREG-1801 to identify any additional aging

effects requiring management.   No additional aging effects requiring management were identified beyond those identified using the methods described in Section 3.6.2.1 of the LRA.

The applicant's ongoing review of plant-specific and industry-wide experience is conducted in accordance with the plant Operating Experience Program.

3.6.2 Staff Evaluation

In Section 3.6 of the LRA, the applicant describes its AMR for electrical and I&C systems at VCSNS. The staff reviewed LRA Section 3.6 to determine whether the applicant has provided sufficient information to demonstrate that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB throughout the period of extended operation, in accordance with the requirement of 10 CFR 54.21(a)(3), for electrical and I&C system components that are determined to be within the scope of license renewal and subject to an AMR.

The applicant referenced the GALL Report in its AMR. The staff has previously evaluated the adequacy of the aging management of electrical and I&C system components for license renewal as documented in GALL Report. Thus, the staff did not repeat its review of the matters described in the GALL Report, except to ensure that the material presented in the LRA was applicable, and to verify that the applicant had identified the appropriate program as described and evaluated in the GALL Report. The staff also reviewed aging management information submitted by the applicant that was different from that in the GALL Report or was not addressed in the GALL Report. Finally, the staff reviewed the FSAR supplement to ensure that it provided an adequate description of the programs credited with managing aging for the electrical and I&C system components.

Table 3.6-1 below provides a summary of the staff's evaluation of components, aging effects/mechanisms, and AMPs listed in LRA Section 3.6 that are addressed in the GALL Report.

Table 3.6-1: Staff Evaluation Table for VCSNS Electrical Components Evaluation in the GALL Report

Component Group	Aging Effect/Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
Electrical equipment subject to 10 CFR 50.49 EQ requirements	Degradation due to various aging mechanisms	Environmental qualification of electrical components	B.3.1	TLAA, See Section 4.4 of the SER

Table 3.6-1: Staff Evaluation Table for VCSNS Electrical Components Evaluation in the GALL Report				
Component Group	**Aging Effect/Mechanism**	**AMP in GALL Report**	**AMP in LRA**	**Staff Evaluation**
Electrical cables and connections not subject to 10 CFR 50.49 EQ requirements	Embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced insulation resistance (IR); electrical failure caused by thermal/thermoxidative degradation of organic; radiolysis and photolysis (ultraviolet [UV] sensitive materials only) of organic; radiation-induced oxidation; moisture intrusion	Aging management program for electrical cables and connections not subject to 10 CFR 50.49 EQ requirements	B.2.9	Not consistent with GALL (See Section 3.6.2.3.1 below)
Electrical cables used in instrumentation circuits not subject to 10 CFR 50.49 EQ requirement that are sensitive to reduction in conductor resistance	Embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced IR; electrical failure caused by thermal/thermoxidative degradation of organic; radiation-induced oxidation; moisture intrusion	Aging management program for electrical cables used in instrumentation circuits not subject to 10 CFR 50.49 EQ requirements	B.2.9	Non-GALL program (See Section 3.6.2.3.2 below)
Inaccessible medium-voltage (2 kV to 15 kV) cables (e.g., installed in conduit or direct buried) not subject to 10 CFR 50.49 EQ requirements	Formation of water trees, localized damage leading to electrical failure (breakdown of insulation); water trees caused by moisture intrusion	Aging management for inaccessible medium-voltage cables not subject to 10 CFR 50.49 EQ requirements	No AMP required	See Section 3.6.2.3.3 below
Electrical connectors not subject to 10 CFR 50.49 requirements that are exposed to borated water leakage	Corrosion of connector contact surfaces caused by intrusion of borated water	Boric acid corrosion	B.1.2	Consistent with GALL (See Section 3.6.2.3 below)

3.6.2.1 Aging Management Evaluation in the GALL Report That Are Relied On for License Renewal, That Do Not Require Further Evaluation

For component groups evaluated in GALL for which the applicant has claimed consistency with GALL, and for which GALL does not recommend further evaluation, the staff sampled components in these groups to determine whether the plant-specific components contained in these GALL component groups were bounded by the GALL evaluation. The staff also sampled component groups to determine whether the applicant had properly identified those component groups in GALL that were not applicable to its plant. The staff also identified several areas where additional information or clarification was needed. The staff's evaluation of applicant's responses to those RAIs are included in Sections 3.6.2.3.1, 3.6.2.3.2, and 3.6.2.3.3 of this SER.

On the basis of its review, the staff has verified the applicant's claim of consistency with the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended functions will be maintained consistent with the current licensing basis for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.6.2.2 Aging Management Evaluations in the GALL Report That Are Relied On For License Renewal, For Which GALL Recommends Further Evaluation

For component groups evaluated in GALL for which the applicant has claimed consistency with GALL, and for which GALL recommends further evaluation, the staff reviewed the applicant's evaluation to determine whether it adequately addressed the issues for which GALL recommended further evaluation. In addition, the staff sampled components in these groups to determine whether the plant-specific components contained in these GALL component groups were bounded by the GALL evaluation.

3.6.2.2.1 Electrical Equipment Subject to Environmental Qualification

Environment qualification is a TLLA as defined in 10 CFR 54.3. TLLAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). The staff reviewed the evaluation of this TLAA separately in Section 4.4 of this SER, following the guidance in Section 4.4 of the SRP-LR.

3.6.2.3 Aging Management Programs for Electrical and Instrumentation and Controls Components

In SER Section 3.6.2.1, the staff determined that the applicant's AMRs and associated AMPs will adequately manage component aging in electrical and I&C systems. The staff then reviewed specific electrical and I&C components to ensure that they were properly evaluated in the applicant's AMR.

To perform this review, the staff reviewed the components listed in LRA Tables 2.5-1, 2.5-2, and 2.5-3 to determine whether the applicant has properly identified the applicable AMRs and AMPs needed to adequately manage the aging effects for the components. This portion of the staff review involved identification of the aging effects for each component, ensuring that each aging effect was evaluated using the appropriate AMR in Section 3, and that management of the aging effect was captured in the appropriate AMP. The results of the staff's review are provided below.

The staff also reviewed the FSAR supplement for the AMPs credited with managing aging in electrical and I&C system components to determine whether program descriptions adequately describe the programs.

The applicant credits two AMPs to manage the aging effects associated with electrical and I&C components. One of these AMPs is credited to mange aging for components in other system group (common AMPs), while the other AMP is credited with managing aging only for electrical and I&C components. The staff's evaluation of the common AMP credited with managing aging in electrical and I&C components is provided in Section 3.0.3 of this SER. The common AMP is Boric Acid Corrosion Surveillance, SER Section 3.0.3.1.

The staff's evaluation of the electrical and I&C component system AMP is provided here.

3.6.2.3.1 Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements

Summary of Technical Information in the Application

Non-EQ Insulated Cables:

The applicant stated that non-EQ insulated cables include power cables, control cables, and instrument cables. For VCSNS, the applicant defines these applications to be at the following voltage levels:

1.12 low voltage cables — 480 VAC, 240/120 VAC, 125 VDC (and less)
- medium voltage cables — 7.2 kV
- high voltage cables — greater than 7.2 kV (none in scope)

In order to facilitate the review of the cables at VCSNS, the applicant places cables into two categories — power cable and I&C cable. The power cable category includes all 7.2 kV cables and the 480 VAC power cables. The I&C category includes the 480 VAC control cable, all 240/120 VAC cable, and all DC cables (125 VDC and less). Depending upon their application, cables utilized as switchboard wire are placed into one of these two categories, typically as I&C cable. The applicant indicated that VCSNS purchased nearly all of its electric power cable, control cable, and instrument cable (with the exception of certain communication cables, cables ordered for specific non-safety applications, and special cables ordered subsequently for specific modifications) to 10 CFR 50.49 harsh EQ standards.

The worst case cable insulation possible in application used in license renewal is polyethylene with a 60 year service limiting temperature of 131 °F. The non-EQ insulated cables will be subject to an AMP as described in Table 3.6.1.

Non-EQ Electrical Connectors:

The applicant stated that cable connections are used to connect the cable conductors with other cables or with a variety of electrical devices (e.g., instruments, motors, etc.). The various types of insulated cable connections (or terminations) are identified in the Cable Aging Management Guideline (AMG). The Cable AMG describes the cable termination grouping as follows:

- compression connectors
- fusion connectors
- plug-in/multi-pin connectors

The applicant reviewed a variety of plant documents to identify electrical connectors in use at VCSNS, including procurement records, plant drawings, EQ binders, and plant maintenance documents. This review provided reasonable assurance that all types of connectors have been identified and that the bounding materials for the connectors at VCSNS have also been identified. Connectors are included in the Non-EQ Insulated Cables and Connections Inspection Program.

Non-EQ Electrical Splices:

The applicant stated that many of the splices at VCSNS are delineated in a calculation which identifies all safety-related (Class 1E) 7.2 kV and 480V splices in the plant. The building of material table for the electric cables lists common splice and tape materials ordered for VCSNS during plant construction. The identification of VCSNS splices included a review of EQ documentation, procurement records, and design basis documents. This review provided reasonable assurance that all splice types and materials applicable to VCSNS (which may be subject to AMR) have been identified. Non-EQ splices are included in the Non-EQ Insulated Cables and Connections Inspection Program.

Non-EQ Terminal Blocks:

A terminal block consists of an insulating base with fixed metallic points for landing wires (conductors) or for connecting terminal rings (lugs). Terminal blocks are typically installed in an enclosure such as a control board, motor control center (MCC) , motor, terminal box, or a panel. A complete list of the specific terminal blocks used at VCSNS does not exist in one file or location; however, a review of the Bills of Material and other plant documents (EQ files, etc.) for general electrical equipment revealed that the following suppliers have terminal blocks in use at VCSNS — GE, Kulka, Marathon, States, and Weidmuller. From the Cable AMG, the most common materials used in the insulating base are phenolic, melamine resin, and nylon. The material with the least thermal and radiation resistance is nylon. Because there is no single document that lists all terminal block manufacturers, materials, and locations for VCSNS, nylon was chosen as the bounding material for the evaluation of the terminal blocks, due to its limited radiation resistance. By choosing nylon as the limiting material with respect to the plant environmental conditions, there is reasonable assurance that the terminal blocks at VCSNS are properly evaluated with respect to aging. Non-EQ terminal blocks are included, as appropriate, in the Non-EQ Insulated Cables and Connections Inspection Program.

<u>Staff Evaluation</u>

Aging Effects:

In Table 3.6-1, the applicant identified embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced insulation resistance (IR), electrical failure caused by thermal/thermoxidative degradation of organics, radiolysis and photolysis (ultraviolet [UV] sensitive materials only) of organics, radiation-induced oxidation, and moisture intrusion are the aging effects of cables and connections due to heat or radiation. The staff concurs with the aging effects identified by the applicants. These aging effects are consistent with the aging effects identified by the staff in the GALL Report.

The aging effects identified in the LRA for the electrical cables and connections not subject to 10 CFR 50.49 environmental qualification requirements are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs:

The applicant stated that the Non-EQ Insulated Cables and Connections Inspection Program is consistent with GALL AMP XI.E1, "Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements." However, having evaluated the applicant's Non-EQ Insulated Cables and Connections Inspection Program, the staff found that the applicant's AMP did not agree with the GALL XI.E1 AMP. The staff requested the applicant to explain how the applicant's AMP is consistent with the GALL XI.E1 AMP (RAI 3.6-1).

In a letter dated March 10, 2003, the NRC forwarded to the Nuclear Energy Institute (NEI) and Union of Concerned Scientists an interim staff guidance (ISG)-5 on the identification and treatment of electrical fuse holders for license renewal (ADAMS Accession Number ML030690512). The staff position indicated that fuse holders should be scoped, screened, and included in the AMR in the same manner as terminal blocks and other types of electrical connections that are currently being treated in the process. This position only applies to fuse holders that are not part of a larger assembly such as switchgear, power supplies, power inverters, battery chargers, circuit boards, etc. Fuse holders in these types of active components would be considered to be piece parts of the larger assembly and not subject to an AMR.

Operating experience as discussed in NUREG-1760 (Aging Assessment of Safety-Related Fuses Used in Low- and Medium-Voltage Applications in Nuclear Power Plants) identified that aging stressors such as vibration, thermal cycling, electrical transients, mechanical stress, fatigue, corrosion, chemical contamination, or oxidation of the connections surfaces can result in fuse holder failure. The staff requested the applicant to provide details of AMR for fuse holders as discussed in the ISG-5 (RAI 3.6-5).

In response to the staff request, in a letter dated June 12, 2003, the applicant stated that Section B 2.9 of the LRA has been revised to (1) clarify the consistency of the VCSNS AMP to the XI.E1 program as identified in NUREG-1801, and (2) incorporate the AMP for fuse holders. Based upon the issuance of ISG-5, in-scope, non-EQ, passive fuse holders will be included within the same commodity group as terminal blocks. This commodity is in the cables and connections commodity group of NEI 95-10. Fuse holders will be specifically included in scoping, screening, and AMR methodology, and will be handled in a manner consistent with ISG-5. In addition to the visual inspection of in-scope, passive fuse holders on a 10-year periodicity for indication of age related degradation, the metallic fuse clip portion of the in-scope, passive fuse holders that are found to be susceptible to age-related degradation through the AMR process, will receive a continuity check or will undergo thermography or other appropriate test on a representative sample basis to assure that the metallic fuse flip is still making a good connection. This will serve to give additional assurance that evidence of age related degradation from fatigue, mechanical stress, vibration, chemical contamination, and corrosion will be discovered prior to a loss of intended function. The staff found the applicant's response acceptable because it revised the VCSNS AMP to be consistent the GALL XI.E1 program, clarified the differences between the two AMPs, and included aging management for the fuse holders.

The staff evaluated the revised B.2.9 AMP. The evaluation of the applicant's AMP focused on program elements rather than the details of specific plant procedures. To determine whether the applicant AMP is adequate to manage the effect of aging so that the intended function will be consistent with CLB for the period of extended operation, the staff evaluated the following seven elements — (1) scope of program, (2) preventive action, (3) parameter monitored or

inspected, (4) detection of aging effects, (5) monitoring and trending, (6) acceptance criteria, and (7) operating experience. The staff's evaluation of the applicant's corrective action, confirmation process, and administrative controls is provided separately in Section 3.0.4 of the SER.

[Program Scope] The specific non-EQ insulated cables and connections that will be included in the AMP for VCSNS include accessible non-EQ insulated cables and connections, including splices, terminal blocks, and fuse holders, that are found susceptible to potential degradation in adverse thermal and radiological areas of the plant. Selection of the areas to be inspected shall include considerations for circuits with potentially significant ohmic heating. While certain areas of the intermediate and auxiliary buildings will be the focus, there will be flexibility to inspect cables and connections in a variety of environmental zones, as determined by the responsible electrical engineering group at VCSNS. The technical basis for the location selected will be documented and will consider both thermally and radiologically adverse environments, as well as considerations such as ohmic heating, vibration, mechanical stress for fuse clips, etc. Passive, non-EQ fuse holders located outside of active devices that have been identified as being susceptible to aging effects in the AMR will be considered within the scope of this program. Equipment and components located inside an active device or panel are not within the scope of this program. An active device is characterized as an assembly or enclosure made up of parts or subcomponents built to perform a specific function. Examples of active devices include switchgear, MCCs, power supplies, inverters, battery chargers, control panels, and equipment racks. The staff considers the scope of the program acceptable because it includes all cables and connections that are subject to potentially adverse localized environments that can result in applicable aging effects on these cable and connections.

[Preventive Actions] No actions are taken as a part of the Non-EQ Insulated Cables and Connections Inspection Program to prevent aging effects or to mitigate aging degradation, and the staff did not identify the need for such actions.

[Parameters Monitored or Inspected] The parameters to be inspected as a part of the Non-EQ Insulated Cables and Connections Inspection Program include visual evidence of cable jacket or connection surface abnormalities such as embrittlement, cracking, swelling, discoloration, surface contamination, presence of standing water or moisture, or any other visible evidence of age-related degradation, which may lead to loss of the intended function. The metallic fuse clip portion of any in-scope, passive fuse holders found to be susceptible to aging effects will be additionally monitored due to aging stressors such as vibration, thermal cycling, electrical transients, mechanical stress, fatigue, corrosion, chemical contamination, or oxidation of the connecting surfaces. In this AMP, thermography, contact resistance testing, or other appropriate tests will be used to identify any existence of aging degradation for these fuse clips. These parameters will be monitored or inspected on a representative sample basis. The technical basis for the sample selected will be documented. The staff found the approach acceptable because visual inspection provides means for monitoring the applicable effects for in-scope insulated cables and connections. Testing/thermography provides means for monitoring the applicable aging effects for metallic portions of fuse holders.

[Detection of Aging Effects] The Non-EQ Insulated Cables and Connections Inspection Program, conducted in the thermally and radiologically severe areas of the plant containing in-scope cables and connections will serve to detect degradation of cable and connections, which could ultimately lead to electrical failure. During each inspection, visual evidence of jacket or

surface abnormalities such as embrittlement, cracking, swelling, discoloration, melting, degradation of organics, radiation-induced oxidation, and moisture intrusion will be evaluated. The inspection program will be initially performed prior to the period of extended operation and then at 10-year intervals thereafter. Identified fuse holders within the scope of license renewal that are located outside of an active device or panel and found to be potentially susceptible to age related degradation will likewise be inspected/tested at least once every 10 years commencing prior to the period of extended operation. The staff found that the inspection technique for accessible non-EQ cables and connections is acceptable on the basis that (1) the AMP is focused on detecting change in material properties of the conductor insulation, which is the applicable aging effect when cables and connections are exposed to adverse, localized environment and (2) testing will detect aging degradation of metallic portions of fuse holders.

[Monitoring and Trending] Trending actions are not included as a part of this program because the ability to trend inspection results is limited. Documentation of these inspections will be available in subsequent inspections for comparison, review, and evaluation. Although not a requirement, test and inspection results that are trendable may provide additional information on the rate of degradation. The staff found absence of trending acceptable because the ability to trend inspection results is limited and the staff did not see a need for such activities.

[Acceptance Criteria] The Non-EQ Insulated Cables and Connections Inspection Program consists of visual inspections for degradation of cable and connections jackets and surfaces due to aging. The accessible cables and connections are to be free from unacceptable visual indications of surface anomalies, which suggest that conductor insulation or connection degradation exists. Acceptance criteria are based on the cable and connection insulation service life. The service life evaluation of the insulation material includes consideration of the material's mechanical and electrical properties and their performance in ambient environments under plant operational conditions of temperature, radiation, and humidity, as well as ohmic heating effects. The results of the Non-EQ Insulated Cables and Connections Inspection Program will serve as input into the service life evaluation of the cable and connections. An unacceptable inspection indication is defined as a noted condition or situation that, if left unmanaged, could lead to a loss of the intended function. The acceptance criteria for each test performed on the fuse clip portion of in-scope, passive, non-EQ fuse holders susceptible to age-related degradation is defined by the specific type of test performed. The staff found these acceptance criteria acceptable because they should ensure that the cables and connections intended functions are maintained under all CLB design conditions for the period of extended operation.

[Operating Experience] Industry experience has shown that adverse localized environments caused by heat or radiation for electrical cables and connections may exist next to or above (within 3 feet of) steam generators, pressurizer, or hot process pipes, such as feedwater lines. These adverse localized environments have been found to cause degradation of the insulating materials on electrical cables and connections that is visually observable, such as color changes or surface cracking. These visual observations can be used as indicators of potential degradation. The staff found that the proposed AMP will detect the adverse localized environment caused by heat, radiation, or moisture of electrical cables and connections.

FSAR Supplement: The applicant needs to provide a summary description of a revised non-EQ cables and connections AMP as required by 10 CFR 54.21(d), to be added in the FSAR supplement in Appendix A of the LRA. By letter dated September 2, 2003, the applicant

provided a summary description of the revised non-EQ cables and connections AMP in Section 18.2.18, Appendix A to the LRA. With this revision, the staff concludes that the FSAR supplement provides an adequate summary of program activities as required by 10 CFR 54.21(d).

On the basis of its review, the staff finds that the AMP credited in the LRA for the electrical cables and connections not subject to 10 CFR 50.49 environmental qualification requirements will effectively manage or monitor aging effects identified in the LRA.

Conclusions

On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.6.2.3.2 Electrical Cables and Connections Not Subject to 10 CFR50.49 Environmental Qualification Requirement Used in Instrumentation Circuits

Summary of Technical Information in the Application

The applicant stated that the Non-EQ Insulated Cables and Connections Inspection Program will be consistent with GALL Program XI.E2, "Electrical Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits" and will have the following clarification:

> The calibration of instrumentation circuits as a means to detect age-related degradation of cable insulation as identified in XI.E2 is not included in the VCSNS program. The visual inspection of instrument as well as power and control cables is considered a better means to identify age-related degradation due to localized ambient thermally and radiologically indued stress prior to loss of intended function. The cables addressed by XI.E2 are therefore bounded by the XI.E1 cable AMP.

Staff Evaluation

The applicant stated that the calibration of instrumentation circuits as a means to detect age-related degradation of cable insulation as identified in GALL Program XI.E2 is not included in the VCSNS program. The visual inspection of instrument, as well as power and control, cables is considered a better means to identify age-related degradation due to localized ambient thermally and radiologically indued stress prior to loss of intended function. The cables addressed by XI.E2 are therefore bounded by the XI.E1 cable AMP.

The staff is not convinced that aging of these cables will initially occur on the outer jacket resulting in sufficient damage that visual inspection will be effective in detecting the degradation before IR losses lead to a loss of its intended function, particularly if the cables are also subjected to moisture. Therefore, the staff requested the applicant to provide a technical justification that will demonstrate that visual inspection will be effective in detecting damage before current leakage can affect instrument loop accuracy or propose an alternate aging management activity (RAI 3.6-2). In response to the staff's above concern, the applicant, in a letter dated June 12, 2003, stated that VCSNS will establish a GALL-type program for relevant, non-EQ, in-scope I&C cables with sensitive, low-level signals for the nuclear instrumentation

(NI) and radiation monitoring (RM) systems. The program will use the guidance of the GALL program as well as considering the proposed changes to the GALL program as has recently been presented to the NRC in meetings with the License Renewal Electrical Working Group (LREWG). A description of this new program is considered consistent with NUREG-1801 Program XI.E2. For those relevant, non-EQ, in-scope I&C cables with sensitive, low-level signals for which the cable is not specifically included in the loop calibration process, an "Alternate XI.E2" program is being reviewed by the LREWG. It is the applicant's intention to consider implementation of an alternate program, when appropriate, after the industry finalizes the approach.

Aging Effects:

In Table 3.6-1, the applicant identified embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced IR, electrical failure caused by thermal/thermoxidative degradation of organic, radiation-induced oxidation, and moisture intrusion. The staff agrees with the scope of the aging effects identified by the applicant. These aging effects are consistent with the aging effects identified by the staff in the GALL Report.

The aging effects identified in the LRA for the electrical cables and connections not subject to 10 CFR 50.49 EQ requirements used in instrumentation circuits are consistent with industry operating experience for the materials and environments listed. The staff finds all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs:

The staff evaluated the proposed XI.E2 and alternate XI.E2 AMP. The evaluation of the applicant's AMP focused on program elements rather than the details of specific plant procedures. To determine whether the applicant AMP is adequate to manage the effect of aging so that the intended function will be consistent with CLB for the period of extended operation, the staff evaluated the following seven elements — (1) scope of program, (2) preventive action, (3) parameter monitored or inspected, (4) detection of aging effects, (5) monitoring and trending, (6) acceptance criteria, and (7) operating experience. The staff's evaluation of the applicant's corrective action, confirmation process, and administrative controls is provided separately in Section 3.0.4 of the staff's SER.

<u>XI.E2 Electrical Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used In Instrumentation Circuits</u>

[Program Scope] This program applies to electrical cables used in circuits with sensitive, high voltage, low-level signals. At VCSNS, this includes radiation monitoring and nuclear instrumentation cables. The staff found the scope of the program acceptable because these cables are part of the calibration program and are sensitive low-level signal, that are subject to potentially adverse localized environments.

[Preventive Actions] No actions are taken as part of this program to prevent or mitigate aging degradation and the staff did not identify the need for such actions.

[Parameters Monitored or Inspected] The parameters monitored are determined from the specific calibrations or surveillances performed and are based on the specific instrumentation circuit under surveillance or being calibrated, as documented in the calibration or surveillance procedures. The staff found this approach to be acceptable because it provides a means for monitoring the aging effects of the non-EQ electrical cables used in instrumentation circuits.

[Detection of Aging Effects] Review of calibration results or findings of surveillance programs can provide indication of aging effects by monitoring key parameters and providing data based on acceptance criteria related to instrumentation circuit performance. Reviews of results obtained during normal calibrations or surveillances provide reasonable assurance that severe aging degradation will be detected prior to loss of the cable's intended function. The first reviews for license renewal are to be completed before the period of extended operation and every 10 years thereafter. All calibrations or surveillances that fail to meet acceptance criteria will be reviewed at the time of surveillance. The staff found this to be acceptable because the reviews of calibration or surveillance that fail to meet the acceptance criteria will provide reasonable assurance that age-related degradation of the cable will be detected prior to loss of cable's intended function.

[Monitoring and Trending] Trending actions are not included as part of this program because the ability to trend test results is dependent on the specific type of test chosen. Although not a requirement, test results that are trendable provide additional information on the rate of degradation. The staff found the absence of trending to be acceptable because the ability to trend test results is dependent on the specific type of test chosen.

[Acceptance Criteria] Calibration results or findings of surveillances are to be within the acceptance criteria, as set out in the calibration or surveillance procedures. The staff found the acceptance criteria acceptable because surveillance activity as set out in the plant technical specifications should ensure that the cable's intended functions used in instrumentation circuits are maintained under all CLB design conditions during the period of extended operation.

[Operating Experience] Changes in instrument calibration data can be caused by degradation of the circuit cable and are a possible indication of potential electrical cable degradation. The applicant did not address the operating experience at VCSNS or industry operating experience. The staff requested the applicant to address this element. The applicant responded, in a letter dated September 2, 2003, that the VCSNS XI.E2 program is a new program for which there is no operating experience. An examination of plant CERs since 1998 shows that there were two cases of radiation monitor for ratemeter problems attributed to cable failures at the ratemeter in the cabinet. One failure was due to moisture on the cable and the other failure was due to proximity to an electrical field. These instances were not due to cable age-related causes. The staff found the applicant's response acceptable because it addresses the operating experience attribute.

<u>Alternate XI.E2 Non-EQ Electrical Cables Used in Instrumentation Circuits</u>

[Program Scope] This program applies to electrical cables used in circuits with sensitive, high voltage, low-level signals. At VCSNS, this includes radiation monitoring and nuclear instrumentation cables. It was not clear to the staff which radiation monitoring and nuclear instrumentation cables are included in the alternate XI.E2 program. The staff requested the applicant to identify which cables will be included in the Alternate XI.E2 program. In response

to the staff request, in a letter dated September 2, 2003, the applicant stated that cables for Victoreen steam line high range radiation monitor and for the source, intermediate, and power range neutron detector, fall under the Alternate XI.E2 program. The staff finds that applicant's response acceptable because it identified the scope of cables used in the alternate XI.E2 program and these cables are not part of the calibration program.

[Preventive Actions] No actions are taken as part of this program to prevent or mitigate aging degradation and the staff did not identify the need for such actions.

[Parameters Monitored or Inspected] The parameters monitored include dielectric strength caused by thermal/thermoxidative degradation of organics or radiation-induced oxidation (radiolysis) of organics. The staff found this approach to be acceptable because loss of dielectric strength will lead to reduced insulation resistance.

[Detection of Aging Effects] Cables will be tested at least once every 10 years. Testing may include insulation resistance tests, time domain reflectometry (TDR) tests, I/V testing, or other testing judged to be effective in determining cable insulation condition. Following issuance of a renewed operating license, the initial test will be completed before the end of the initial 40-year license term. The staff found the testing methods acceptable because it provides reasonable assurance that the aging degradation will be detected prior to loss of cable intended function. The staff was concerned about the 10 year testing frequency. The staff requested the applicant to provide justification of why 10 year testing frequency is adequate to detect the aging effects of cables used in instrumentation circuits. The applicant responded, in a letter dated September 2, 2003, that the allowance for a 10-year frequency of testing in the Alternate XI.E2 program is supported by the fact that most of the applicable cable types were procured as Class 1E harsh environment qualified. The instrumentation cables used for in-scope, high voltage, low signal, non-EQ circuits as covered by the XI.E2 and Alternate XI.E2 programs that were procured as harsh qualified are acceptable to use in the harsh EQ application. The current qualified life of these cables is being upgraded to 60 years. This gives a reasonable assurance that a 10-year testing frequency under the Alternate XI.E2 program is acceptable. Based on testing performed prior to the extended period on the more susceptible cables, the specific frequency for future testing will be established. The current commitment is to perform this testing on a frequency no greater than 10 years. The staff finds that testing of these cables on a frequency no greater 10 years is acceptable because these cables were procured EQ cables which are qualified to be used in harsh environments and will be qualified to 60-year life.

[Monitoring and Trending] Trending actions are not included as part of this program because the ability to trend test results is dependent on the specific type of test chosen. Although not a requirement, test results that are trendable provide additional information on the rate of degradation. The staff found absence of trending is acceptable because the ability to trend test results is dependent on the specific type of test chosen.

[Acceptance Criteria] The acceptance criteria for each test is defined by the specific type of test performed and the specific cable tested. The staff found the acceptance criteria acceptable because the specific type of test performed should ensure that cable intended functions used in instrumentation circuits are maintained under all CLB design conditions during the period of extended operation.

[Operating Experience] Operating experience has shown that anomalies found during cable testing can be caused by degradation of the instrumentation circuit cable and are a possible indication of potential cable degradation. The staff found the applicant has addressed the operating experience applicable for this item.

FSAR Supplement: The staff reviewed the proposed Sections 18.2.43 and 18.2.44 for the FSAR supplement (Appendix A to the LRA) and verified that the information provided in the FSAR supplement for the aging management of systems and components discussed above is equivalent to the information in NUREG-1800 and therefore provides an adequate summary of program activities as required by 10 CFR 54.21(d).

On the basis of its review, the staff finds that the AMP credited in the LRA for the electrical cables and Connections not subject to 10 CFR 50.49 EQ requirements used in instrumentation circuits will effectively manage or monitor the aging effects identified in the LRA.

Conclusions

On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.6.2.3.3 Inaccessible Medium-Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements

Summary of Technical Information in the Application

In Table 3.6-1 of the LRA, the applicant states that formation of water trees, localized damage leading to electrical failure (breakdown of insulation) caused by moisture intrusion and water trees are the aging effects/mechanisms of inaccessible medium-voltage cables. However, its AMR for medium-voltage cables exposed to moisture and voltage stressors concluded that aging management at VCSNS was not required. The applicant stated that no instance of power cable failure at VCSNS due to moisture intrusion were found.

Staff Evaluation

Aging Effects:

In Table 3.6-1, the applicant identified formation of water trees, localized damage leading to electrical failure (breakdown of insulation) caused by moisture intrusion and water trees as aging effects. The staff agrees with the scope of the aging effects identified by the applicant. These aging effects are consistent with the aging effects identified by the staff in the GALL Report.

The aging effects identified in the LRA for the inaccessible medium-voltage cables not subject to 10 CFR 50.49 EQ requirements are consistent with industry operating experience for the materials and environments listed. The staff finds all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs:

Inaccessible medium-voltage cables (2 kV -15 kV) may be exposed to condensation and wetting in inaccessible locations, such as conduits, cable trenches, cable troughs, duct banks, underground vaults, or direct buried installations. When an energized medium-voltage cable is exposed to wet conditions for which it is not designed, water treeing or a decrease in the dielectric strength of the conductor insulation can occur. This can potentially lead to electrical failure. The growth and propagation of water trees is somewhat unpredictable. The staff requested the applicant to provide a description of an AMP that will be relied upon to manage the aging effects of water treeing for inaccessible medium-voltage cables (RAI 3.6-3).

In response to the staff's request, in a letter dated June 12, 2003, the applicant stated that water treeing phenomenon must be addressed when relevant in-scope medium voltage underground cables are exposed to moisture together with significant voltage. VCSNS recognizes the potential uncertainties involved with water treeing, even with ducts that are sloped to preclude moisture accumulation, and will create a program consistent with NUREG-1801 Program XI.E3. Relevant cables are limited to that supplying 7.2kv to the service water pump house motors via two underground ducts using Okonite ethylene propylene rubber (EPR) cable with a Hypalon jacket. All other underground 7.2kv cables are either out of the license renewal scope or are energized less than 25 percent of the time. The underground ducts for the relevant cables are sloped to provide drainage. Cable and manhole inspections have shown indications that the relevant cables have been exposed to moisture with significant voltage. The VCSNS program described will result in a 10-year test interval by an appropriate industry-approved testing method selected to validate the satisfactory condition of the cable insulation and to give some assurance of the remaining life of the cable, while not damaging the cable itself. The specific type of test performed will be determined prior to the initial test and will be a proven test for detecting deterioration of the cable insulation system due to wetting. The 10-year interval will commence prior to the start of the period of extended operation. A new program is consistent with the NUREG-1801 Program XI.E3.

In this AMP, periodic actions are taken to prevent or minimize the possibility that cables may be exposed to moisture, such as inspecting for water collection in cable manholes and conduit, and draining water, as needed. In-scope, medium-voltage cables exposed to moisture and significant voltage are tested to provide an indication of the condition of the conductor insulation. The initial test performed will be determined prior to the period of extended operation, and is to be a proven test for detecting deterioration of the insulation system due to wetted conditions at the time the test is performed.

The staff found the applicant's response to the staff's request acceptable because the applicant proposed an AMP to manage the effects of water tree for inaccessible medium-voltage cables in order to provide reasonable assurance that the intended functions of these cables will be maintained consistent with the CLB through the period of extended operation.

The staff evaluated the proposed AMP. The evaluation of the applicant's AMP focused on program elements rather than the details of specific plant procedures. To determine whether the applicant AMP adequate to manage the effect of aging so that the intended function will be consistent with the CLB for the period of extended operation, the staff evaluated the following seven elements — (1) program scope, (2) preventive action, (3) parameter monitored or inspected, (4) detection of aging effects, (5) monitoring and trending, (6) acceptance criteria,

and (7) operating experience. The staff's evaluation of the applicant's corrective action, confirmation process, and administrative controls is provided separately in Section 3.0.4 of the staff's SER.

[Program Scope] The specific non-EQ medium voltage insulated cables subject to moisture and significant voltage that will be included in the AMP for VCSNS includes the two circuits serving the service water pump motors. These circuits are inaccessible as they are routed in underground duct, except at electrical manholes or where they exit the duct bank, and are medium-voltage cables within the scope of license renewal that are potentially exposed to moisture simultaneously with significant voltage. Moisture is defined as periodic exposures to moisture that last more than a few days (e.g., cable in standing water). Periodic exposures to moisture that last less than a few days (i.e., normal rain and drain) are not significant. Significant voltage exposure is defined as being subjected to system voltage for more than 25 percent of the time. The moisture and voltage exposures described as significant in these definitions, which are based on operating experience and engineering judgment, are not significant for medium-voltage cables that are designed for these conditions (e.g., continuous wetting and continuous energization is not significant for submarine cables). The staff found the scope of the program acceptable because it includes inaccessible medium-voltage cables within the scope of license renewal that are exposed to significant moisture with significant voltage.

[Preventive Actions] Periodic actions are taken to prevent or minimize the possibility that cables may be exposed to moisture, such as inspecting for water collection in cable manholes and conduit, and draining water, as needed. Inaccessible medium-voltage cables, which are in the license renewal scope and subject to potential moisture with significant voltage, are to be tested in accordance with this program since operating experience conservatively indicates that the potential exists for exposure to sufficiently prolonged moisture and voltage, which may induce or contribute to this aging mechanism. The staff found it acceptable because in addition to testing of the inaccessible medium-voltage cables that are exposed to significant moisture and voltage, the applicant will periodically inspect for water collection in cable manholes and conduit, and draining water, as needed.

[Parameters Monitored or Inspected] In-scope, medium-voltage cables exposed to moisture and significant voltage will be tested to provide an indication of the condition of the conductor insulation. The specific type of test performed will be determined prior to the initial test, and is to be a proven test for detecting deterioration of the insulation system due to wetting. This will be a test that will not damage the cable itself. The staff found the approach acceptable because the in-scope, medium-voltage cables exposed to significant moisture and significant voltage are tested to provide an indication of the condition of the conductor insulation.

[Detection of Aging Effects] In-scope, medium-voltage cables exposed to moisture and significant voltage are tested at least once every 10 years. This is an adequate period to preclude failures of the conductor insulation since experience has shown that aging degradation is a slow process. A 10-year test frequency will provide two data points during a 20-year period, which can be used to characterize the degradation rate. The first tests for license renewal are to be completed before the period of extended operation. The staff believes, based on current knowledge, that aging degradation of this cabling would be due to a slow acting mechanism, and therefore, the applicant's proposed test schedule is acceptable.

[Monitoring and Trending] Trending actions are not included as part of this program because the ability to trend test results is dependent on the specific type of test chosen. Although not a requirement, test results that are trendable provide additional information on the rate of degradation. The staff finds that the absence of trending for testing is acceptable since the test is performed every 10 years and the staff did not see a need for such activities.

[Acceptance Criteria] The acceptance criteria for each test is defined by the specific type of test performed and the specific cable tested. The staff finds the above acceptance criteria acceptable on the basis that they will follow current industry standard which, when implemented, will ensure that the license renewal intended functions of the cables will be maintained consistent with the CLB.

[Operating Experience] The AMP for Inaccessible Medium-Voltage Cables Not Subject To 10 CRF 50.49 Environmental Qualification Requirements is a new AMP for which there is no operating experience. The relevant in-scope cables included in this program at VCSNS are 7.2kv cables with EPR insulation and a Hypalon jacket. Operating experience has shown that cross-linked polyethylene (XLPE) or high molecular weight polyethylene (HMWPE) insulation materials are most susceptible to water tree formation. The formation and growth of water trees varies directly with operating voltage. Treeing is much less prevalent in 4kV cables than those operated at 13 or 33kV. Also, minimizing exposure to moisture minimizes the potential for the development of water treeing. As additional operating experience is obtained both at VCSNS and in the industry, lessons learned will be considered as proposed enhancements to the program so that the effects of aging will continue to be adequately managed. The staff finds operating experience acceptable because additional operating experience will be satisfactorily incorporated into the development of this new program.

FSAR Supplement: The staff reviewed the proposed Sections 18.2.45 for the FSAR supplement (Appendix A to the LRA) and verified that the information provided in the FSAR supplement for the aging management of systems and components discussed above is equivalent to the information in NUREG-1800 and therefore provides an adequate summary of program activities, as required by 10 CFR 54.21(d).

On the basis of its review, the staff finds that the AMP credited in the LRA for the inaccessible medium-voltage cables not subject to 10 CFR 50.49 EQ requirements will effectively manage or monitor the aging effects identified in the LRA.

Conclusions

On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.6.2.4 Aging Management Review of Plant-Specific Electrical Components

The applicant describes its AMR of plant-specific electrical components in Sections 3.6.1.4, 3.6.1.6, 3.6.1.7, and 3.6.1.8 of the LRA. The staff reviewed these sections of the application to determine whether the applicant has demonstrated that the effect of aging on the electrical components will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

3.6.2.4.1 Non-EQ Electrical Penetration Assemblies

Summary of Technical Information in the Application

The applicant stated that electrical penetration assemblies are utilized to carry electrical circuits through the reactor building containment wall while maintaining pressure-tight integrity. They provide the electrical continuity of the circuit and the pressure boundary for containment integrity. The scope of the review in this report applies only to the electrical function of the penetration assemblies. The pressure-retaining function of the penetration assemblies is addressed in Section 2.4 of this application for the reactor building. All the electrical penetrations at VCSNS have been listed in the VCSNS EQ Program, whether or not they carry Class 1E circuits. The non-Class 1E electrical penetrations are classified as category "B1, B2" components with respect to EQ (i.e., they must not fail and prevent the accomplishment of a safety-related function) and are administratively included in the EQ Program in order to credit the portion of the EQ testing which justifies the pressure-retaining function of the penetrations. VCSNS utilizes D.G. O'Brien electrical penetration for its non-Class 1E applications. The D.G. O'Brien electrical penetration assemblies are subject to AMR. This review provides for their identification and also for the listing of the organic materials found during the review. Because there are D.G. O'Brien electrical penetration assemblies that are part of the VCSNS EQ Program and have been evaluated in detail for that purpose, there is reasonable assurance that all their organic materials have been identified and properly evaluated with respect to aging for the non-EQ installations. An additional review has shown non-EQ electrical penetrations at VCSNS to be located in areas inside and outside of the reactor building which have less severe environments, that are clearly enveloped by material properties and for which aging testing and evaluation has been done through the manufacturer. The non-EQ electrical penetrations at VCSNS are not included in the Non-EQ Insulated Cables and Connections Inspection Program. The component type, material, environment, and aging effects are identified in Table 3.6-2 of the LRA. The evaluation of the non-EQ electrical penetrations at VCSNS is further documented in Table 3.6-2 Item 2 of the LRA.

Aging Effects:

The LRA identified the following aging effects for the non-EQ electrical penetrations:

13. embrittlement
14. cracking
15. melting
16. discoloration
17. swelling
18. loss of dielectric strength leading to reduced insulation resistance
19. electrical failure caused by thermal/thermoxidative degradation of organic
20. radiolysis and photolysis (ultraviolet sensitive materials only) of organic
21. radiation-induced oxidation
22. moisture intrusion

Aging Management Programs:

No AMP is required for non-EQ electrical penetration. The applicant states that a review has shown non-EQ electrical penetrations at VCSNS to be located in areas inside and outside of

the reactor building which have less severe environments, that are clearly enveloped by material properties and for which aging testing and evaluation has been done through the manufacturer. Non-EQ electrical penetrations at VCSNS are not included in the Non-EQ Insulated Cables and Connections Inspection Program.

Staff Evaluation

This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects and the AMPs credited for managing the aging effects in non-EQ electrical penetrations at VCSNS. The staff also reviewed the applicable FSAR supplement for the AMPs to ensure that the program description adequately describe the AMPs.

Aging Effects and Aging Management Programs:

The applicant identified embrittlement, cracking, melting, discoloration, swelling, loss of dielectric strength leading to reduced insulation resistance, electrical failure caused by thermal/thermoxidative degradation of organics, radiolysis and photolysis (ultraviolet sensitive materials only) of organic, radiation-induced oxidation, and moisture intrusion are the aging effects/mechanism of non-EQ electrical penetrations. The staff agrees with the scope of aging effects identified by the applicant. These aging effects are consistent with the aging effects identified by the staff in the GALL Report.

The applicant stated that its review has shown non-EQ electrical penetrations at VCSNS to be located in areas inside and outside of the reactor building which have less severe environments, that are clearly enveloped by material properties and aging testing and evaluation done through the manufacturer. Non-EQ electrical penetrations at VCSNS are not included in the Non-EQ Insulated Cables and Connections Inspection Program.

The staff was not convinced that there are no aging effects for non-EQ electrical penetration because these penetrations are located in a less severe environment and are covered by evaluation done by manufacturer. In most areas within a nuclear power plant, the actual ambient environments are less severe than the nominal plant environment. However, in a limited number of localized areas, the actual environments may be more severe than the nominal plant environment. Insulation materials used in non-EQ electrical penetration assemblies may degrade more rapidly than expected in these adverse localized environments. The staff requested the applicant to provide a description of an AMP for non-EQ electrical penetration exposed to localized environment caused by heat, radiation, or moisture, or provide a technical justification of why an AMP is not necessary (RAI 3.6-4).

In response to the staff's request, in a letter dated June 12, 2003, the applicant stated that all VCSNS electrical penetrations are included within the VCSNS Harsh EQ Program and meet the requirements of 10 CFR 50.49. The non-Class 1E as well as the Class 1E electrical penetrations are considered subject to a TLAA and will be reanalyzed for a 60-year life under the EQ Program. All electrical penetrations have a definitive long-lived qualified life assigned within the EQ database, "HARSH EQ Maintenance Manual", the same as all harsh EQ related equipment. Non-Class 1E electrical penetrations were previously conservatively listed as requiring an AMR because of their non-Class 1E status [reference LRA 3.6.1.4]. The AMR is not required as these electrical penetrations are to receive a TLAA for consideration of a 60-year life. There will be no AMP for electrical penetrations as these electrical penetrations have

a qualified life that is administratively controlled within the EQ Program and are screened out in 54.21(a)(1)(ii). The staff finds the applicant's response acceptable because all electrical penetrations are included within the EQ Program and no AMR is required.

The aging effects identified in the LRA for the non-EQ electrical penetration assemblies are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

<u>Conclusions</u>

On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.6.2.4.2 High Voltage Electrical Switchyard Bus

<u>Summary of Technical Information in the Applicantion</u>

The applicant stated that high voltage (HV) electrical switchyard bus is uninsulated, unenclosed, rigid electrical conductor used in switchyards and switching stations to connect two or more elements of an electrical power circuit, such as active disconnect switches and passive transmission conductors. The review of switchyard bus included the bus itself as well as the hardware used to secure the bus to HV insulators. The in-scope switchyard bus at VCSNS is constructed of aluminum tubing or copper rods, and supported on station post insulators with aluminum cast fastening hardware. For the ambient environmental conditions at VCSNS, no significant aging effects have been identified that would cause a loss of function for the extended period of operation. The potential effects of surface oxidation and vibration are not considered significant for the VCSNS installation. No AMP for HV electrical switchyard bus is required. The components, material, environment, aging effects, and program activity are provided in LRA Table 3.6-2.

Aging Effects:

The LRA identified change in material properties leading to increased resistance and heating due to oxidation, and cracking due to vibration are the applicable aging effects for the HV electrical switchyard bus.

Aging Management Programs:

The applicant stated that for the ambient environmental conditions at VCSNS, no significant aging effects have been identified that would cause a loss of function for the extended period of operation. The potential effects of surface oxidation and vibration are not considered significant for the VCSNS installation. The AMP for HV electrical switchyard bus is not required.

<u>Staff Evaluation</u>

This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects and the AMPs credited for managing the aging effects in HV electrical switchyard bus.

Aging Effects:

The applicant identified change in material properties leading to resistance and heating due to oxidation, and cracking due to vibration are the applicable aging effects for the HV electrical switchyard bus. The aging effects identified in the LRA for the HV electrical switchyard bus are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs:

The applicant stated that for the ambient environmental conditions at VCSNS, no significant aging effects have been identified that would cause a loss of function for the extended period of operation. The potential effects of surface oxidation and vibration are not considered significant for the VCSNS installation. The AMP for HV electrical switchyard bus is not required. The staff requested the applicant to explain in detail why connection surface oxidation of HV electrical switchyard bus are not considered significant aging mechanism at VCSNS (RAI 3.6-6). In response to the staff's request, in a letter dated June 12, 2003, the applicant stated that at VCSNS, the switchyard bus is comprised of copper or 5" schedule 80 aluminum tube. Organic materials are not involved. Connections to the switchyard bus are welded. Conductor connections are generally of the compression bolted category. The switchyard bus is located in the yard, which is the ambient environment of the plant. The temperature ranges from a historic low of -4 °F to a high of 108 °F. The environment is periodically wet (from rainfall). The copper and aluminum materials do not experience any appreciable aging effects in this environment, except for minor oxidation, which does not impact the ability of the switchyard bus to perform its design function. In order to validate aging effects, a review of industry experience was performed. This review included NRC generic communications, LERs, and NUREGs related to switchyard bus. No documents involving switchyard bus were identified. VCSNS operating experience was also reviewed to validate aging effects for switchyard bus and connections. This review included condition evaluation reports (CER) and nonconformance notices (NCN) for any documented instances of switchyard bus aging, in addition to interviews with responsible substation department and VCSNS engineering and maintenance personnel. No instance of age-related problems with in-scope switchyard bus and connections due to contaminants or oxidation was uncovered. The staff finds the applicant's response acceptable because copper and aluminum materials used in HV electrical switchyard bus do not experience any significant aging effects in the environmental conditions at VCSNS that would cause a loss of function for the extended period of operation.

On the basis of its review, the staff finds that an AMP is not required for the HV electrical switchyard bus to manage or monitor the aging effects identified in the LRA.

Conclusions

On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.6.2.4.3 High Voltage Transmission Conductors and Connections

Summary of Technical Information in the Application

The applicant stated that transmission conductors are uninsulated, stranded electrical cables used in switchyards, switching stations, and transmission lines to connect two or more elements of an electrical power circuit, such as active disconnect switches, power circuit breakers, and transformers to passive switchyard bus. The review of transmission conductors included the transmission conductors and the hardware used to secure the conductors to a HV insulator or to switchyard bus. Transmission conductors are supported by passive high-voltage strain or suspension insulators. Transmission conductors and connection hardware at VCSNS are made of aluminum reinforced with galvanized steel. For the ambient environmental conditions at VCSNS, no significant aging effects related to conductor corrosion or wind loading vibration or sway on connections have been identified that would cause a loss of function for the extended period of operation. No AMP for HV transmission conductors and connections is required.

Aging Effects:

The LRA identified loss of conductor strength due to corrosion and wear, or fatigue due to wind loading vibration or sway are the aging effects of HV transmission conductors and connections.

Aging Management Program:

The applicant states that for the ambient environmental conditions at VCSNS, no significant aging effects related to conductor corrosion or wind loading vibration or sway on connections have been identified that would cause a loss of function for the extended period of operation. No AMP for HV transmission conductors and connections is required.

Staff Evaluation

This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects and the AMPs credited for managing the aging effects in HV transmission conductors and connections.

Aging Effects:

The aging effects for transmission line conductors is loss of conductor strength and vibration. The most prevalent mechanism contributing to loss of conductor strength of an aluminum conductor steel reinforced (ACSR) transmission conductor is corrosion, which includes corrosion of the steel core and aluminum strand pitting. For ACSR conductors, degradation begins as a loss of zinc from the galvanized steel core wires. Corrosion rate depend largely on air quality, which includes suspended particles chemistry, SO_2 concentration in air, precipitation, fog chemistry, and meteorological conditions. Transmission conductor vibration would be caused by wind loading. Wind loading can cause a transmission line and insulators to vibrate. Transmission conductor vibration or sway could cause loss of material (wear) and fatigue. The applicant stated that for the ambient environmental conditions at VCSNS, no significant aging effects related to conductor corrosion, or wind loading vibration or sway on connections have been identified that would cause a loss of function for the extended period of operation. No AMP for HV transmission conductors and connections is required. The staff requested the applicant to explain in detail why no aging effects related to conductor corrosion have been identified that would cause a loss of function for the extended period of operation (RAI 3.6-7).

The staff also requested the applicant to explain why no significant aging effects related to wind loading vibration or sway on HV connections has been identified at VCSNS.

In response to the staff's request, in a letter dated June 12, 2003, the applicant cited the following from the EPRI 1003057, License Renewal Electrical Handbook, dated December 2001:

> Regarding HV transmission conductor strength, tests performed by Ontario Hydroelectric showed a 30% loss of composite conductor strength of an 80-year-old ACSR conductor due to corrosion. There is a set percentage of composite conductor strength established at which a transmission conductor is replaced. As illustrated below, there is ample strength margin to maintain the transmission conductor intended function through the extended period of operation.
>
> The National Electrical Safety Code (NESC) requires that tension on installed conductors be a maximum of 60% of the ultimate conductor strength. The NESC also sets the maximum tension a conductor must be designed to withstand under various load requirements, which includes consideration of ice, wind and temperature. These requirements were reviewed concerning the specific conductors included in the AMR. The conductors with the smallest ultimate strength margin (4/0 ACSR) will be used as an illustration. VCSNS is in the medium loading zone; therefore, the Ontario Hydroelectric heavy loading zone study is conservative.
>
> The ultimate strength and the NESC heavy load tension requirements of 4/0 ACSR are 8350 lbs. and 2761 lbs. respectively. The margin between the NESC Heavy Load and the ultimate strength is 5589 lb.; i.e., there is a 67% of ultimate strength margin. The Ontario Hydroelectric study showed a 30% loss of composite conductor strength in an 80-year-old conductor. In the case of the 4/0 ACSR transmission conductors, a 30% loss of ultimate strength would mean that there would still be a 37% ultimate strength margin between what is required by the NESC and the actual conductor strength. The 4/0 ACSR conductors have the lowest initial design margin of any transmission conductors included in the AMR. This illustrates with reasonable assurance that transmission conductors will have ample strength through the period of extended operation. Corrosion of ACSR conductors is a very slow acting aging effect that is even slower for rural areas with generally less suspended particles and SO_2 concentrations in the air than urban areas.

At VCSNS, the transmission conductors are constructed of ACSR material, either 795 kcmil or 1590 kcmil. The shield wire is 3/16" high strength steel. There are no organic materials involved and no appreciable aging effects for the transmission conductors. The connections used for these conductors likewise have no organic materials. There are no applicable aging effects that could cause loss of the intended function of the transmission conductors for the period of extended operation.

Regarding wind loading vibration and sway on HV connections, wind loading that can cause a transmission line and insulators to vibrate is considered in the design and installation. Loss of material (wear) and fatigue that could be caused by transmission conductor vibration or sway are found not to be applicable aging effects in that they would not cause a loss of intended function if left unmanaged for the extended period of operation.

In order to validate aging effects, a review of industry experience was performed. This review included NRC generic communications, LERs, and NUREGs related to transmission conductors. No documents involving transmission conductors were identified.

VCSNS operating experience was also reviewed to validate aging effects for transmission conductors. This review included CERs and NCNs for any documented instances of transmission conductor aging, in addition to interviews with responsible substation department and VCSNS engineering and maintenance personnel. No instance of aging-related problems with transmission conductors was uncovered.

The aging effects identified in the LRA for the HV transmission conductors and connections are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Program:

On the basis of its review, the staff finds that an AMP is not required for the HV transmission conductors and connections to manage or monitor the aging effects identified in the LRA.

Conclusions

On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.6.2.4.4 High Voltage Insulators

Summary of Technical Information in the Application

The applicant stated that HV switchyard post insulators, and strain or suspension insulators as typically used on transmission towers, are insulating materials in a form designed to (a) support a conductor physically and (b) separate the conductor electrically from another conductor or object. The insulators evaluated for license renewal are those used to support and insulate HV electrical components in switchyards, switching stations, and transmissions, such as transmission conductors and switchyard bus. HV insulators serve as an intermediate support between a supporting structure (such as a transmission tower or support pedestal) and the switchyard bus or transmission conductor. Materials of construction include porcelain, metal (insulator cap and pin) and cement to join the cap or pins to the porcelain. For the ambient environmental conditions at VCSNS, no significant aging effects related to airborne contaminants or mechanical wear have been identified that would cause a loss of function for the extended period of operation. No AMP for HV insulators is required.

Aging Effects:

The LRA identified surface contamination or cracking due to airborne contaminants and loss of material due to mechanical wear are the aging effects of HV insulators.

Aging Management Programs:

No AMP for HV insulator is required. For the ambient environmental conditions at VCSNS, no significant effects related to airborne contaminant or mechanical wear have been identified that would cause a loss of function for the extended period of operation.

Staff Evaluation

This section provides the results of the staff's evaluation of the applicant's AMR for the aging effects and the AMPs credited for managing the aging effects in HV insulators. The staff also

reviewed the applicable FSAR supplement for the AMPs to ensure that the program descriptions adequately describe the AMPs.

Aging Effects:

The potential aging effects for insulator are as follows:

- surface contamination
- cracking
- loss of material due to wear

Various airborne materials such as dust, salt, and industrial effluents can contaminate insulator surfaces. A large buildup of contamination enables the conductor voltage to track along the surface more easily and can lead to insulator flashover. Surface contamination can be a problem in areas where there are greater concentrations of airborne particles such as near facilities that discharge soot or near the sea coast where salt spray is prevalent.

Porcelain is essentially a hardened, opaque glass. As with any glass, if subjected to enough force it will crack or break. Cracks have also been known to occur with insulators when the cement that binds the part together expands enough to crack the porcelain. This phenomenon is known as cement growth.

Mechanical wear is an aging effects for strain and suspension insulators in that they are subject to movement. Movement of the insulators can be caused by wind blowing the supported transmission conductor, causing it to swing from side to side. If this swing is frequent enough, it could cause wear in the metal contact points of the insulator string and between an insulator and the supporting hardware.

In LRA Table 3.6-2, the applicant identified that surface contamination or cracking due to airborne contaminants and loss of material due to mechanical wear are the potential aging effects of HV insulators. However, the applicant did not explain why, for the ambient environmental conditions at VCSNS, no significant aging effects related to airborne contaminants or mechanical wear have been identified that would cause a loss of function for the extended period of operation and no AMP for HV insulators is required. The staff requested the applicant to explain why no significant aging effects were identified at VCSNS (RAI 3.6-8). In response to the staff request, in a letter dated June 12, 2003, the applicant stated that from the EPRI 1003057, License Renewal Electrical Handbook, dated December 2002, the potential for contamination of insulators, the buildup of surface contamination is gradual and in most areas such contamination is washed away by rain; the glazed insulator surface aids this contamination removal. A large buildup of contamination enables the conductor voltage to track along the surface more easily and can lead to insulator flashover. Surface contamination can be a problem in areas where there are greater concentrations of airborne particles such as near facilities that discharge soot or near the seacoast where salt spray is prevalent. VCSNS is located in an area with moderate rainfall where airborne particle concentrations are comparatively low; consequently, the rate of contamination buildup on the insulators is not significant. At VCSNS, as in most areas of the SCE&G transmission system, contamination buildup on insulators is not a problem due to rainfall periodically “washing” the insulators. Additionally, there is no nearby heavy industry or other producers of industrial effluents, which could cause excessive contamination. There is no salt spray at VCSNS as the plant is over 100

miles from the ocean. Therefore, surface contamination is not an applicable aging effect for the insulators in the service conditions they are exposed to at VCSNS.

Regarding HV porcelain insulator cracking, the most common cause for cracking or breaking of an insulator is being struck by an object (e.g., a rock or bullet). Cracking and breaking caused by physical damage is not an aging effect and is not subject to an AMR. Cracks have been known to occur with insulators when the cement that binds the parts together expands enough to crack the porcelain. This phenomenon, known as cement growth, occurs mainly because of improper manufacturing processes or materials, which make the cement more susceptible to moisture penetration, and the specific design and application of the insulator. The string insulators susceptible to porcelain cracking caused by cement growth are isolated to bad batches (specific known brands and manufacture dates) of string insulators used in strain application. The post insulators most susceptible to this aging effect are multi-cone (post) insulators used in cantilever applications. Research of NCNs and CERs within the VCSNS database and discussions with the substation department personnel revealed no instance of insulator cracking or failure related to cement growth at the VCSNS switchyard.   Accordingly, cracking due to cement growth is not an applicable aging effect for the HV switchyard insulators in the service conditions they are exposed to at VCSNS.

Regarding mechanical wear, although this mechanism is possible, experience has shown that the transmission conductors do not normally swing and that when they do, due to a substantial wind, do not continue to swing for very long once the wind has subsided. Wind loading that can cause a transmission line and insulators to vibrate or sway is considered in the design and installation. The loss of material due to wear concern will not cause a loss of intended function of the insulators at VCSNS; therefore, loss of material due to wear is not an applicable aging effect for insulators.

VCSNS operating experience was reviewed to validate aging effects for switchyard insulators. This review included CERs and NCNs for any documented instances of switchyard insulator aging, in addition to interviews with responsible substation department and VCSNS engineering and maintenance personnel. No instance of aging-related problems with in-scope switchyard insulators due to contaminants, cracking, cement growth, or mechanical wear was uncovered.

The aging effects identified in the LRA for HV insulators are consistent with industry operating experience for the materials and environments listed. The staff finds that all the plausible aging effects were identified and that the aging effects listed are appropriate for the combination of materials and environments specified.

Aging Management Programs:

On the basis of its review, the staff finds that an AMP is not required for transmission insulators to manage or monitor the aging effects identified in the LRA.

Conclusions

On the basis of its review, the staff finds the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.6.3 References

1. Sandia Contractor Report SAND 96-0344, Aging Management Guideline for Commercial Nuclear Power Plant - Electrical Cable and Terminations, prepared by Ogden Environmental and Energy Services, Inc., printed September 1996.

2. Aging and Life Extension of Major Light Water Reactor Components, edited by V.N. Shaw and P.E. MacDonald, 1993, Elsevier Science Publishers.

3. Electric Power Research Institute Report, EPRI TR-103834-P1-2, Effects of Moisture on the Life of Power Plant Cables, Part 1: Medium-Voltage Cables, Part 2: Low-Voltage Cables, prepared by Ogden Environmental and Energy Services Company, Final Report, August 1994.

3.7 Conclusion for Aging Management

On the basis of its review of AMR results and AMPS, the staff concludes that actions have been identified and have been or will be taken to manage the effects of aging during the period of extended operation on the functionality of SCs subject to an AMR such that there is reasonable assurance that the activities authorized by a renewed license will continue to be conducted in accordance with the CLB, as required by 10 CFR 54.29(a).

THIS PAGE IS INTENTIONALLY LEFT BLANK

4 TIME-LIMITED AGING ANALYSES

4.1 Identification of Time-Limited Aging Analyses

This section addresses the identification of time-limited aging analyses (TLAAs). The applicant discusses the TLAAs in the license renewal application (LRA), Sections 4.2 through 4.7. The staff's review of the TLAAs can be found in Sections 4.2 through 4.7 of this SER.

The TLAAs are certain plant-specific safety analyses that are based on an explicitly assumed 40-year plant life. Pursuant to Section 54.21(c)(1) of Title 10 of the *Code of Federal (CFR)*, the applicant for license renewal provides a list of TLAAs, as defined in 10 CFR 54.3.

In addition, pursuant to 10 CFR 54.21(c)(2), an applicant must provide a list of plant-specific exemptions granted under 10 CFR 50.12 that are based on TLAAs. For any such exemptions, the applicant must provide an evaluation that justifies the continuation of the exemptions for the period of extended operation.

4.1.1 Summary of Technical Information in the Application

The applicant evaluated calculations for the Virgil C. Summer Nuclear Station (VCSNS) against the six criteria specified in 10 CFR 54.3 to identify the TLAAs. The applicant indicated that calculations which meet the six criteria were identified by searching the current licensing basis (CLB), which includes the updated safety analysis report (UFSAR), Technical Specifications, engineering calculations, technical reports, docketed licensing correspondence, and applicable Westinghouse topical reports. The applicant listed the following TLAAs in Table 4.1-1 of the LRA:

- reactor vessel neutron embrittlement; including upper shelf energy, pressurized thermal shock, and pressure-temperature limits
- metal fatigue; including ASME Section III Class 1 components, and ASME Section III Class 2 and 3 piping
- environmental qualification
- concrete containment tendon prestress analysis
- containment liner and penetration fatigue analysis
- reactor coolant pump flywheel
- leak-before-break analyses
- crane load cycle limit
- service water intake structure settlement

Pursuant to 10 CFR 54.21(c)(2), the applicant stated that no exemptions granted under 10 CFR 50.12 that were based on a TLAA as defined in 10 CFR 54.3 were identified.

4.1.2 Staff Evaluation

In LRA Section 4.1, the applicant identified the TLAAs applicable to VCSNS and discussed exemptions based on TLAAs. The staff reviewed the information to determine whether the applicant provided adequate information to meet the requirements of 10 CFR 54.21(c)(1) and 10 CFR 54.21(c)(2).

As indicated by the applicant, TLAAs are defined in 10 CFR 54.3 as analyses that meet the following six criteria:

- involve systems, structures, and components within the scope of license renewal, as delineated in Section 54.4(a)

- consider the effects of aging

- involve time-limited assumptions defined by the current operating term, for example, 40 years

- were determined to be relevant by the licensee in making a safety determination

- involve conclusions or provide the basis for conclusions related to the capability of the system, structure, and component to perform its intended functions, as delineated in Section 54.4(b)

- are contained or incorporated by reference in the CLB

The applicant listed the TLAAs applicable to VCSNS in Table 4.1-1 of the LRA. Tables 4.1-2 and 4.1-3 in NUREG-1800 identify potential TLAAs determined from the review of other LRAs. In its request for additional information (RAI) 4.1-1, the staff requested that the applicant discuss whether there are any calculations or analyses at VCSNS that address the topics listed in Tables 4.1-2 and 4.1-3 of NUREG-1800 and were not included in Table 4.1-1 of the LRA.

In its response dated June 12, 2003, the applicant indicated that the following items listed in NUREG-1800, potentially applicable to PWRs, were not addressed in Section 4.0 of the LRA:

- metal corrosion allowance

- inservice flaw growth analysis that demonstrates structural stability for 40 years

- inservice local metal containment corrosion analyses

- intergranular separation in the heat-affected zone (HAZ) of reactor vessel low-alloy steel under austenitic stainless steel cladding, low-temperature overpressure protection (LTOP) analyses

- flow-induced vibration endurance limit, transient cycle count assumptions, and ductility reduction of fracture toughness for the reactor vessel internals

- containment penetration pressurization cycles

The applicant indicated that VCSNS does not have any calculations or analyses that evaluate intergranular separation of the HAZ of reactor vessel low-alloy steel under austenitic stainless steel cladding. The applicant indicated that this issue was addressed in response to RAI 3.1.2.2.7-1. The staff evaluation of this issue is contained in Section 3.1.2.2.7 of this safety evaluation report (SER). The applicant also indicated that the LTOP analysis is performed when vessel specimens are analyzed and the pressure temperature curves are revised. A discussion of this topic is contained in Section 4.2 of this SER. The applicant indicated that VCSNS does not have any calculations or analyses that address the remaining topics. The staff review of the VCSNS FSAR Supplement did not identify any TLAAs related to these topics. On the basis of the preceding discussion, the staff finds the applicant's response to RAI 4.1-1 acceptable.

4.1.3 Conclusions

On the basis of its review, the staff concludes that the applicant has provided an acceptable list of TLAAs as required by 10 CFR 54.21(c)(1), and has confirmed that no 10 CFR 50.12 exemptions have been granted on the basis of a TLAA, as required by 10 CFR 54.21(c)(2).

4.2 Reactor Vessel Neutron Embrittlement

In Section 4.2 of the LRA and Section 18.3.1 of Appendix A to the LRA, the applicant provides a discussion of its evaluation of the effects of neutron irradiation on the integrity of the reactor vessel. Specifically, the applicant has determined that the neutron embrittlement affects the ability of the vessel to (a) maintain acceptable Charpy upper shelf energy values during the period of extended operation, (b) resist failure during a pressurized thermal shock (PTS) event, and (c) operate safely using guidance from calculated pressure-temperature (P-T) operating limit curves.

The regulations governing reactor vessel integrity are contained in the following sections of 10 CFR Part 50:

- 10 CFR 50.60, "Acceptance Criteria for Fracture Prevention Measures for Light Water Nuclear Power Reactors for Normal Operation," which requires all light water reactors to meet the fracture toughness, P-T limits, and material surveillance program requirements for the reactor coolant boundary as set forth in Appendices G and H of 10 CFR 50.60.

- 10 CFR 50.61, "Fracture Toughness Requirements for Protection Against Pressurized Thermal Shock Events," which contains fracture toughness requirements for protection against PTS.

The staff's evaluation of the reactor vessel neutron embrittlement TLAAs is provided below.

4.2.1 Upper Shelf Energy

4.2.1.1 Summary of Technical Information in the Application

Appendix G to 10 CFR Part 50, "Fracture Toughness Requirements," requires that reactor vessel beltline materials must have an initial, pre-irradiated, Charpy Upper Shelf Energy (USE) of no less than 75 ft-lbs. and must maintain a Charpy USE of no less than 50 ft-lbs. throughout the life of the reactor vessel.

VCSNS calculated the beltline fluence for the determination of the decrease in Charpy USE due to radiation embrittlement and thermal aging of the reactor vessel. VCSNS then calculated the Charpy USE values for the beltline region materials using Regulatory Guide (RG) 1.99, Revision 2, "Radiation Embrittlement of Reactor Vessel Materials." In response to the U.S. Nuclear Regulatory Commission's (NRC) Generic Letter 92-01, Revision 2, "Reactor Vessel Structural Integrity," Revision 1, VCSNS reported the end of current license 32 effective full-power years (EFPYs) USE for the limiting beltline material to be 67.5 ft-lbs. for the intermediate plate A9154-1. The response to NRC Generic Letter 92-01 was based upon examinations of the first three VCSNS surveillance capsules.

VCSNS has two surveillance capsules remaining in the vessel. These capsules will be kept in the vessel until they receive sufficient additional exposure to neutron fluence in order to provide data that correlates to the estimated fluence on the vessel at the end of the extended period of operation. VCSNS will then withdraw these two capsules and analyze one and place the other one in storage. The Charpy USE will then be recalculated for additional fast neutron fluence corresponding to the end of the extended operating period. Therefore, as discussed above, VCSNS is utilizing 10 CFR 54.21 (c)(1)(ii) to calculate the reactor pressure vessel (RPV) Charpy USE to the end of the extended operating period.

4.2.1.2 Staff Evaluation

The staff reviewed the USE evaluations contained in Section 4.2.1 of the LRA and Section 18.3.1.1 of Appendix A to the LRA. The staff issued RAI 4.2.2.1-1, in which it requested that the applicant submit 60-year end-of-life (EOL) USE values for each of the beltline materials and requested that the applicant address how surveillance capsule results were evaluated in its determination of the USE values. In a letter dated June 12, 2003, in response to RAI 4.2.2.1-1, the applicant indicated that (1) the EOL for VCSNS is 54 EFPY, and (2) the 54-EFPY fluence (E > 1.0 MeV) values may be found in Table 6-14 of Westinghouse Commercial Atomic Power report (WCAP-15101, "Analysis of Capsule W from the South Carolina Electric & Gas Company V. C. Summer Unit 1 Reactor Vessel Radiation Surveillance Program," dated September 1998.)

The WCAP report was attached to a letter from G. J. Taylor, South Carolina Electric & Gas Co. (SCE&G), to NRC Document Control Desk, dated October 9, 1998. This WCAP report contains the data from the test results of capsule W that was removed after 10.8 EFPYs with a lead factor of 3.40. The applicant states that the intermediate shell plate has 0.10 wt% Cu and is the limiting plate material. The highest percent of copper in the weld material is 0.05 wt%. The staff confirmed the data provided by the applicant by reviewing the data for the VCSNS reactor vessel materials against the data in the NRC Reactor Vessel Integrity Database (RVID). The staff determined that the intermediate shell plate, A9154-1, is the limiting plate material and its Cu and Ni contents are 0.10 wt% and 0.51 wt%, respectively. The staff noted that the VCSNS reactor vessel beltline materials have welds of only one heat, 4P4784, and their Cu and Ni contents are 0.05 wt% and 0.91 wt%, respectively.

The surveillance plate has Charpy test results from longitudinally oriented specimens, but does not have Charpy data from transversely oriented specimens. Therefore, to determine whether the plate material is in compliance with 10 CFR Part 50, Appendix G, the staff and the applicant must estimate the transverse properties from the longitudinal properties. The applicant states that the unirradiated USE value for the limiting plate is 132 ft-lbs. in the longitudinal direction, and 91 ft-lbs for the limiting weld material. The applicant also states that the unirradiated USE value for the limiting plate in the transverse direction is 75 ft-lbs., which is 56.8 percent of the USE value in the longitudinal direction. The staff estimated the unirradiated USE value for the plate material in transverse direction according to the guidance provided in Section 5.3.2 of the NRC report, "Standard Review Plan for the Review of Safety Analysis Reports for the Nuclear Power Plants," NUREG-0800, 1987. According to this NUREG report, the USE of the plate specimens in the transverse direction is 65 percent of that in the longitudinal direction and, therefore, is equal to 85.8 (0.65 x 132) ft-lbs., which is greater than the one reported by the applicant. The staff finds the unirradiated USE value of 75 ft-lbs. for the limiting plate material in the transverse direction acceptable for two reasons: (1) the unirradiated USE value is less than the one estimated using the guidance provided in NUREG-0800 and (2) the ratio of unirradiated USE value in the transverse to the longitudinal direction bounds the corresponding ratio of the measured USE values for the irradiated surveillance specimens as discussed in the next paragraph.

As reported in WCAP-15101, the measured USE at a fluence of 4.664E+19 n/cm^2 for the limiting plate is 126 ft-lbs. in the longitudinal direction and 74 ft-lbs. in the transverse direction. In other words, the measured USE value in the transverse direction is 58.7 percent of the one along the longitudinal direction. The measured USE at a fluence of 4.664E+19 n/cm^2 for the limiting weld material is 87 ft-lbs. The staff made independent estimates of corresponding USE values using the curves in Figure 2 of RG 1.99, Revision 2. The staff estimated that at a fluence of 4.664E+19 n/cm^2, the percentage drop in the USE value for the limiting plate and weld materials is 16 percent. The corresponding USE value for the limiting plate is 111 (132 x 0.84) lbs. in the longitudinal direction, which is less than the measured value. The staff estimate is based on an unirradiated USE of 84 ft-lbs, which is the value reported in the RVID. Similarly, the estimated USE value for the limiting weld is 71 (84 x 0.84) ft. lbs., which is less than the measured value. In other words, the estimated USE values, using RG 1.99, Revision 2 methodology, for both the limiting plate and weld materials are lower than the measured values. Since the values using RG 1.99, Revision 2 are lower than the measured values, the RG predicts conservative values.

The applicant provides the following information about the EOL USE values. The highest 54-EFPY fluence value listed in Table 6-14 of the WCAP report is 6.40 x 10^{19} n/cm^2, which is the calculated value at the vessel ID surface. The highest 54-EFPY fluence value at 1/4T is 4.29 x 10^{19} n/cm^2. Using curves in Figure 2 of RG 1.99, Rev. 2, the applicant estimates the predicted decrease in USE to be 31 percent for the limiting beltline plate material with 0.10 wt% Cu and EOL fluence of 6.40 x 10^{19} n/cm^2. This would reduce the USE for the limiting plate material from the unirradiated values of 132 ft-lbs. in the longitudinal direction and 75 ft-lbs. in the transverse direction to EOL values of 91 ft-lbs. and 51.75 ft-lbs., respectively. The applicant uses 91 ft-lbs. as an unirradiated USE value for the weld material. This value is higher than the one reported in the RVID (i.e., 84 ft-lbs.). For the weld material, the drop in USE reduces the unirradiated value of 91 ft-lbs. to EOL value of 62 ft-lbs.

The staff performed independent calculations using the RVID data for estimating EOL USE values for the limiting plate material and weld material. The staff independently verified, using Figure 2 of RG 1.99, Revision 2, and the Cu composition values for the limiting beltline plate and weld materials, that the estimated drop in USE values for the limiting plate and weld materials is the same and equal to 29.5 percent. In determining the percentage drop, the staff used the fluence at 1/4T. This is the applicable fluence because the fluence is taken at the 1/4T depth that corresponds to the depth of the flaw assumed to exist for the USE evaluation. The corresponding EOL USE values for the limiting plate material are 93 (132 x 0.705) ft-lbs. in the longitudinal direction and 54 (84 x 0.705) ft-lbs. in the transverse direction. For the limiting weld metal it is 59 (75 x 0.705) ft-lbs. Thus, the EOL USE values for the limiting plate material, as calculated by the staff, are higher than those reported by the applicant, and are higher than 50 ft-lbs. The EOL USE value for the limiting weld, as calculated by the staff, is about 5 percent lower than the one reported by the applicant, but is also higher than 50 ft-lbs. The staff finds the EOL USE values for the VCSNS limiting plate and weld metals acceptable because they are greater than 50 ft-lbs and, therefore, satisfy the Charpy USE requirements of 10 CFR 50, Appendix G at the end of the period of extended operation.

Pursuant to the requirements of 10 CFR 54.21(d), the applicant provided the FSAR Supplement description of the upper-shelf-energy (USE) as part of the reactor vessel (RV) neutron embrittlement TLAA in Section 18.3.1.1 of Appendix A, FSAR Chapter 18 of the LRA. The staff noted that the applicant did not provide its calculation of the USE for the end of the period of extended operation in the FSAR Supplement; therefore, the staff requested that the applicant provide its projected calculation of the USE for the period of extended operation and indicate where it is documented. By letter dated September 24, 2003, the applicant revised the FSAR Supplement for Section 18.3.1.1 to indicate that the projected calculation of the USE for the period of extended operation is documented in WCAP-15101, “Analysis of Capsule W for the South Carolina Electric & Gas Company, V.C. Summer Unit 1 Reactor Vessel Radiation Surveillance Program,” dated September 1998.

4.2.1.3 Conclusions

On the basis of its review, the staff concludes that the applicant has provided an acceptable demonstration, pursuant to 10 CFR 54.21(c)(1)(ii), that the analyses have been projected to the end of the period of extended operation for the upper-shelf energy as part of the reactor vessel neutron embrittlement TLAA. The staff also concludes that the FSAR Supplement contains an appropriate summary description of the upper-shelf energy as part of the reactor vessel neutron embrittlement TLAA evaluation for the period of extended operation, as discussed above. The staff has reasonable assurance that the safety margins established and maintained during the current operating term will be maintained during the period of extended operation, as required by 10 CFR 54.21(c)(1)(ii).

4.2.2 Pressurized Thermal Shock

4.2.2.1 Summary of Technical Information in the Application

10 CFR 50.61, “Fracture Toughness Requirements for Protection Against Pressurized Thermal Shock Events,” includes fracture toughness requirements for protection against pressurized thermal shock. The requirements include screening criteria for the maximum nil-ductility

reference temperature in the limiting beltline material (RT_{PTS}). The RT_{PTS} values must remain below the screening criteria values of 270 °F for plates, forgings, and longitudinal welds, and 300 °F for circumferential welds.

The VCSNS RT_{PTS} values for the current 40-year operating term were calculated in accordance with the method of WCAP-15103. This method is consistent with Regulatory Guide 1.99, Revision 2 and 10 CFR 50.61. The applicant reports that the calculated RT_{PTS} values for all the beltline materials in the VCSNS reactor vessel have end-of-life (32 EFPY) and extended life (48 EFPY) RT_{PTS} values below the PTS screening criteria. The applicant states that the RT_{PTS} value will be recalculated when one of the two remaining VCSNS surveillance capsules is removed from the vessel. As mentioned, the applicant intends to test at least one of the capsules when the calculated fast fluence on the capsules meets or exceeds the calculated fast fluence on the vessel wall at the end of the extended operating period. Therefore, VCSNS elects to utilize 10 CFR 54.21(c)(1)(ii) to calculate the RT_{PTS} data to the end of the extended operating period.

4.2.2.2 Staff Evaluation

The staff reviewed the PTS evaluations contained in Section 4.2.2 of the LRA and Section 18.3.1.2 of Appendix A to the LRA. The method used by the applicant to calculate RT_{PTS} is acceptable because it is consistent with RG1.99, Revision 2 and 10 CFR 50.61. The staff issued RAI 4.2.2.2-1 requesting that the applicant submit a table of the VCSNS 60-year EOL RT_{PTS} values for each of the beltline material along with its heat number, material ID, copper and nickel values, chemistry factor, initial RT_{NDT}, margin, EOL peak fluence, and fluence factor. The RAI also requested the applicant to discuss how surveillance capsule results were applied in its determination of the RT_{PTS} values. In response to RAI 4.2.2.2-1 in a letter dated June 12, 2003, the applicant refers to two WCAP reports attached to a letter from G. J. Taylor, SCE&G, to NRC Document Control Desk, dated October 9, 1998. These reports included WCAP-15101, "Analysis of Capsule W from the South Carolina Electric & Gas Company V. C. Summer Unit 1 Reactor Vessel Radiation Surveillance Program," September 1998, and WCAP-15103, "Evaluation of Pressurized Thermal Shock for V. C. Summer Unit 1," September 1998. These two WCAP reports contain the data from the test results of capsule W that was removed after 10.8 EFPYs with a lead factor of 3.40. The applicant states that the intermediate shell plate has 0.10 wt% Cu and is the limiting plate material. The highest percentage of copper in the weld material is 0.05 wt%. The staff confirmed the data provided by the applicant by reviewing the data for the VCSNS reactor vessel materials in the NRC RVID. The staff determined that the intermediate shell plate, A9154-1, is the limiting plate material and its Cu and Ni contents are 0.10 wt% and 0.51 wt%, respectively. The staff also determined that the VCSNS reactor vessel beltline materials have welds of only one heat, 4P4784, and their Cu and Ni contents are 0.05 wt% and 0.91 wt%, respectively. Table 1 in WCAP-15103 provides the following data for the initial, unirradiated, values of RT_{NDT} for the limiting materials: 30 °F for plate A9154-1 and -44 °F for weld 4P4784. The staff confirmed this data for the unirradiated RT_{NDT} by reviewing the corresponding data in RVID. WCAP-15101 presents somewhat different data for the initial, unirradiated RT_{NDT}: 28 °F for plate A9154-1, in the transverse direction, and -53 °F for weld 4P4784. In determining the RT_{PTS} values, the applicant used the most limiting values; therefore, the initial (unirradiated) RT_{NDT} values used in calculating the RT_{PTS} values are 30 °F and -44 °F for the plate and weld, respectively. The staff found this acceptable because the applicant used the most limiting values of the initial RT_{NDT} value in determining the RT_{PTS} values.

WCAP-15101 presents the following results for the surveillance capsule W, the fourth capsule removed from the VCSNS RPV. The capsule received an average neutron fluence (E>1.0 MeV) of 4.664E+19 n/cm^2 after 10.78 EFPYs of plant operation. This resulted in 30-ft-lbs transition temperature increase ($\triangle RT_{NDT}$) of 58 °F for plate A9154-1 in the transverse direction, and 43 °F for weld 4P4784. The staff made independent estimates of the corresponding $\triangle RT_{NDT}$ values using the chemistry factor from the tables in 10 CFR 50.61 and a neutron fluence of 4.664E+19 n/cm^2. For plate A9154 with 0.10 wt% Cu and 0.51 wt% Ni, the chemistry factor is 65 °F and the $\triangle RT_{NDT}$ is 94 °F. Similarly, for weld 4P4784 with 0.05 wt% Cu and 0.91 wt% Ni, the chemistry factor is 68 °F and the $\triangle RT_{NDT}$ is 98 °F. The comparison of measured and estimated results shows that the measured results for $\triangle RT_{NDT}$ for the surveillance plate and weld materials are smaller than the corresponding estimated values using Tables 1 and 2 of 10 CFR 50.61. Therefore, using the RG 1.99, Revision 2 methodology for calculating the chemistry factor and the $\triangle RT_{NDT}$ is conservative.

The EOL for VCSNS is 54 EFPY. The highest 54-EFPY fluence value listed in Table 6-14 of the WCAP report is 6.40 x 10^{19} n/cm^2, which is the calculated value at the vessel ID surface. For the margin term, M, the applicant uses 34 °F for the limiting plate material and 56 °F for the limiting weld material. The staff finds these margin values acceptable because they are in accordance with 10 CFR 50.61.

In determining the 54 EFPY RT_{PTS} value for the limiting plate, the staff used the equation in 10 CFR 50.61 which is the sum of the initial RT_{NDT} value (30 °F) and the $\triangle RT_{NDT}$ value (90°F) and the margin term (34°F) which results with the RT_{PTS} value of 158 °F. In using the same equation, the staff independently calculated the RT_{PTS} value of the weld, which is the sum of the initial RT_{NDT} value (-44 °F) and the $\triangle RT_{NDT}$ value (98 °F) and the margin term (56 °F) which results with the RT_{PTS} value of 110 °F. The staff compared its RT_{PTS} values to those of the applicant's values and found the applicant's values to be acceptable because they were approximately the same as those calculated by the staff. The staff also finds the applicant's values of the RT_{PTS} acceptable because the projected 54-EFPY RT_{PTS} values satisfy the PTS screening criteria of 10 CFR 50.61(b)(2) at the end of the period of extended operation.

Pursuant to the requirements of 10 CFR 54.21(d), the applicant provided the FSAR Supplement description of the PTS as part of the reactor vessel neutron embrittlement TLAA in Section 18.3.1.2 of Appendix A, "FSAR Chapter 18," to the LRA. The staff noted that the applicant did not provide its calculation of the PTS for the end of the period of extended operation in the FSAR Supplement; therefore, the staff requested that the applicant provide its projected calculation of the PTS for the period of extended operation and indicate where it is documented.

By letter dated September 24, 2003, the applicant revised the FSAR Supplement for Section 18.2.1.2 to indicate that the calculation of the PTS for the end of the period of extended operation is documented in WCAP-15101, "Analysis of Capsule W for the South Carolina Electric & Gas Company, V.C. Summer Unit 1 Reactor Vessel Radiation Surveillance Program," dated September 1998.

4.2.2.3 Conclusions

On the basis of its review, the staff concludes that the applicant has provided an acceptable demonstration, pursuant to 10 CFR 54.21(c)(1)(ii), that, for the PTS as part of the reactor vessel neutron embrittlement TLAA, the analyses will be projected to the end of the period of

extended operation. The staff also concludes that the FSAR Supplement contains an appropriate summary description of the PTS as part of the reactor vessel neutron embrittlement TLAA evaluation for the period of extended operation, as discussed above. The staff has reasonable assurance that the safety margins established and maintained during the current operating term will be maintained during the period of extended operation, as required by 10 CFR 54.21(c)(1)(ii).

4.2.3 Pressure-Temperature Limits

4.2.3.1 Summary of Technical Information in the Application

Section 4.2.3 of the LRA and Section 18.3.1.3 of Appendix A to the LRA addresses P-T limits for the VCSNS vessel. The LRA describes how P-T curves are constructed. Beltline fluence is one of the factors used to revise P-T limits for heatup and cooldown due to radiation embrittlement of the reactor vessel. This input is based on calculations of an adjusted reference temperature (ART) using methodology of RG 1.99, Rev. 2. This methodology is very similar to that used to calculate the RT_{PTS} value. However, the calculation of ART also considers attenuation of the fast neutron fluence through the vessel wall to the depth of the postulated flaw.

The calculated ART is refined in conjunction with the analysis of each successive surveillance capsule. Allowable P-T curves are generated for steady state and each finite cooldown rate specified, assuming a reference flaw at the inside surface of the most limiting reactor vessel beltline material. A composite cooldown limit curve is constructed as the minimum of each of these curves. Similarly, allowable P-T curves are generated for steady state and for each finite heatup rate specified considering each of the worst-case reference flaw locations, either at the vessel outside surface or inside surface.

The applicant states that current VCSNS heatup and cooldown curves are based on calculations for the current 40-year period. VCSNS will revise the calculated value for ART and associated P-T limits for heatup and cooldown when one of the two remaining surveillance capsules is removed from the vessel. The applicant intends to remove at least one of the capsules when the calculated fast fluence on the capsules meets or exceeds the calculated fast fluence on the vessel wall at the end of the extended operating period. Therefore, VCSNS elects to utilize 10 CFR 54.21(c)(1)(iii) to construct the P-T curves to the end of the extended operating period.

4.2.3.2 Staff Evaluation

The staff reviewed the information in Section 4.2.3 of the LRA and Section 18.3.1.3 of Appendix A to the LRA describing the general procedure for generating P-T curves for the reactor vessel beltline materials through the period of extended operation. The applicant determines the ARTs using methodology of RG 1.99, Revision 2. From the ART values, the applicant constructs P-T limit curves applicable for 40 years of operation in accordance with the requirements of 10 CFR 50, Appendix G. The applicant states that the current VCSNS P-T curves are based on calculations for current 40-year operating term. The applicant will revise the calculated values of the ART and the associated P-T curves when one of the two remaining surveillance capsules is removed from the vessel and analyzed. The applicant intends to remove the two remaining

reactor surveillance capsules in order to obtain data that correlates to estimated fluence on the vessel at the end of extended operation. The Technical Specifications will be updated as required by 10 CFR Part 50. Therefore, the P-T limit analyses will be projected for the period of extended operation. This is acceptable because the staff will evaluate the recalculated ART values and associated P-T curves for the VCSNS reactor vessel beltline materials in accordance with the P-T limits requirements of 10 CFR Part 50, Appendix G, when the applicant submits them for an approval pursuant to the license amendment requirements of 10 CFR 50.90.

The applicant has not provided any information about the maximum allowable low-temperature overpressure protection (LTOP) system power-operated relief valve (PORV) set points that are applicable for current 40-year operating period. The staff issued RAI 4.2.2.3-1 requesting the applicant to identify LTOP as part of the reactor vessel neutron embrittlement TLAA and commit to develop LTOP values for the period of extended operation, as was done for the P-T limits. In response to RAI 4.2.2.3-1, in a letter dated June 12, 2003, the applicant states that at VCSNS, the LTOP analysis is part of the calculation that develops the heatup and cooldown curves from analysis of the reactor vessel surveillance specimens. The applicant further states that the LTOP analysis will be done as part of the recalculation of the P-T curves when one of the two remaining surveillance capsules is removed from the vessel and analyzed. The staff finds this response acceptable because the applicant will submit the LTOP analysis along with the recalculated ART values and associated P-T curves as mentioned in the preceding paragraph for staff approval.

Pursuant to the requirements of 10 CFR 54.21(d), the applicant provided the FSAR Supplement description of the TLAA for the P-T limits in Section 18.3.1.3 of Appendix A, FSAR Chapter 18, to the LRA. The applicant states that the P-T limit curves for the period of extended operation will be constructed after the removal of the remaining two capsules. The remaining capsules must incur additional exposure to neutron fluence in order to provide data that correlates to the estimated fluence on the vessel at the end of the period of extended operation. Since the NRC staff will review the revised P-T limit curves along with the LTOP limits and approve them, the staff finds the applicant’s FSAR Supplement statement to be acceptable.

4.2.3.3 Conclusions

On the basis of its review, the staff concludes that the applicant has provided an acceptable demonstration, pursuant to 10 CFR 54.21(c)(1)(iii) that, the analyses will be projected to the end of the period of extended operation for the P-T limits as part of the reactor vessel neutron embrittlement TLAA. The staff also concludes that the FSAR Supplement contains an appropriate summary description of the P-T limits as part of the reactor vessel neutron embrittlement TLAA evaluation for the period of extended operation. Therefore, the staff has reasonable assurance that the safety margins established and maintained during the current operating term will be maintained during the period of extended operation, as required by 10 CFR 54.21(c)(1).

4.3 Metal Fatigue

A metal component subjected to cyclic loading at loads less than the static design load may fail due to fatigue. Metal fatigue of components may have been evaluated based on an assumed

number of transients or cycles for the current operating term. The validity of such metal fatigue analysis is reviewed for the period of extended operation.

4.3.1 Summary of Technical Information in the Application

The reactor vessel and major reactor coolant system (RCS) components were designed to the ASME Boiler and Pressure Vessel Code, Section III requirements for Class 1 components.

The applicant indicated that Class 1 components have been designed using the transient cycle assumptions in Table 5.2-2 of the FSAR. The applicant indicated that the VCSNS Inservice Inspection Program involves monitoring of thermal transients. The applicant uses the Thermal Fatigue Monitoring Program (TFMP) to track thermal transients. The TFMP is discussed in Section B.3.2 of the LRA. The applicant indicated that enhancements to the program are warranted to incorporate the new guidance in Electric Power Research Institute (EPRI) Report MRP-47, “Materials Reliability Program Guidelines for Addressing Fatigue Environmental Effects in a License Renewal Application.” The applicant made a commitment to revise the TFMP to account for the effects of the reactor coolant environment, in accordance with NUREG-1801, Section X.M.1, prior to the period of extended operation.

The applicant discussed the evaluation of ASME Class 2 and 3 and American National Standards Institute (ANSI) B31.1 components in Section 4.3.2 of the LRA. ASME Class 2 and 3 and ANSI B31.1 require that a stress reduction factor be applied to the allowable thermal bending stress range if the number of full range cycles exceeds 7,000. The applicant indicated that most piping systems within the scope of license renewal are only subject to occasional cyclic operation and, consequently, the analyses will remain valid during the period of extended operation. However, the applicant did indicate that the RCS loop sampling line could exceed the 7,000 cyclic limit during the period of extended operation. The applicant indicated that either procedural controls would be implemented to assure the number of cycles remains below the 7,000 cycle or the calculation would be revised to verify the acceptability of the number of actual cycles.

4.3.2 Staff Evaluation

As discussed in the previous section, components of the RCS at VCSNS were designed to the Class 1 requirements of the ASME Code. These requirements contain explicit criteria for the fatigue analysis of components. Consequently, the applicant identified the fatigue analysis of these components as TLAAs. The staff reviewed the applicant’s evaluation of the RCS components for compliance with the provisions of 10 CFR 54.21(c)(1).

The specific design criterion for fatigue analysis of RCS components involves calculating the cumulative usage factor (CUF). The fatigue damage in the component caused by each thermal or pressure transient depends on the magnitude of the stresses caused by the transient. The CUF sums the fatigue damage resulting from each transient. The design criterion requires that the CUF not exceed 1.0. The applicant indicated that the Thermal Fatigue Monitoring Program monitors the design transients at VCSNS. In RAI 4.3-1, the staff requested that the applicant provide the following information for each of the transients monitored at VCSNS:

- the current number of operating cycles and a description of the method used to determine the number of the design transients from the plant operating history;

- the number of operating cycles estimated for 60 years of plant operation and a description of the method used to estimate the number of cycles at 60 years; and

- a comparison of the thermal fatigue transients monitored with the transients listed in Table 5.2-2 of the FSAR, identification of any transients listed in the FSAR that are not monitored by the VCSNS Thermal Fatigue Monitoring Program (TFMP) and explanation of why it is not necessary to monitor these transients.

The applicant's June 12, 2003, response indicated that critical components were monitored using the Westinghouse program WESTEMS. The applicant uses WESTEMS to monitor transient cycles for the following locations:

- reactor vessel inlet and outlet nozzles
- reactor vessel shell
- reactor coolant loop hot and cold leg piping
- steam generator primary sides
- steam generator feedwater nozzles
- reactor coolant pump casings
- pressurizer upper shell
- pressurizer spray nozzle
- auxiliary spray piping
- letdown piping
- excess letdown piping
- safety injection piping
- safety injection accumulator piping
- residual heat removal piping

In addition, the applicant uses WESTEMS to monitor fatigue usage at the following locations:

- normal charging nozzle
- alternate charging nozzle
- pressurizer lower head
- pressurizer surge line reactor coolant loop nozzle locations
- pressurizer surge line nozzle locations

The applicant's response also included its 2002 yearly review of cycle counts from WESTEMS. The applicant indicated that WESTEMS does not monitor hydrostatic tests. The hydrostatic tests are monitored by a hand count and are included in the yearly review. The staff verified that the monitored transients, provided in the 2002 yearly review, include the transients listed in FSAR Supplement Table 5.2-2. The applicant's evaluation indicated that a significant percentage of the allowable cycles of feedwater cycling and auxiliary pressurizer spray cycles had accumulated. However, the applicant indicated that the current rate of cycle accumulation had slowed, and that it did not expect the fatigue limits for these components to be exceeded during the period of extended operation. The applicant's evaluation of the WESTEMS data for those locations monitored for fatigue usage indicates that three components may exceed the design basis fatigue usage factor during the period of extended operation. These components

are the charging nozzle, alternate charging nozzle and pressurizer surge line reactor coolant loop nozzle. In accordance with the Thermal Fatigue Monitoring Program, the applicant must take corrective actions prior to exceeding the fatigue usage limit for these components. In accordance with GALL Program X.M1, acceptable corrective actions include: a more rigorous analysis of the component to demonstrate that the design code limit will not be exceeded; repair, or replace part of the component.

The Westinghouse Owners Group issued topical report WCAP-14577, Revision 1-A, “Aging Management for Reactor Internals,” to address the aging management of the reactor vessel internals (RVI). The staff’s review of WCAP-14577, Rev. 1-A identified a number of issues that should be addressed on a plant-specific basis. Renewal Applicant Action Item 11, specified in WCAP-14577, Rev. 1-A, indicates that the fatigue TLAA of the RVI should be addressed on a plant specific basis. In the LRA, SCE&G indicates that the VCSNS Inservice Inspection Program involves monitoring of thermal transients. In RAI 4.3.1-2, the staff requested that the applicant list the transients that contribute to the fatigue usage for each component listed in Table 3-3 of WCAP-14577, Rev.1 1-A and discuss how the Inservice Inspection Program monitors these transients.

The applicant’s June 12, 2003, response indicated that the code of record for the RVI is ASME Section III, Class 2, which does not specify a fatigue analysis. The applicant further indicated that VCSNS (AMP) B.2.4, Reactor Vessel Internal Inspection, will monitor the components listed in WCAP-14577, Table 3-3. The staff’s review of the VCSNS FSAR Table 3.2-1 confirmed the applicant’s statement that the RVI is classified as ASME, Section III, Class 2. Therefore, the staff finds the applicant’s response acceptable. The staff review of the Reactor Vessel Internal Inspection AMP is contained in Section 3.1.2.3.7 of this SER.

The Westinghouse Owners Group issued topical report WCAP-14575-A, “Aging Management Evaluation for Class 1 Piping and Associated Pressure Boundary Components,” to address aging management of the RCS piping. Tables 3-2 through 3-16 of WCAP-14575-A list RCS components where fatigue is considered significant. The staff review of WCAP-14575-A identified a number of issues that should be addressed on a plant-specific basis. Renewal Applicant Action Item 8 requests that the applicant address components labeled I-M and I-RA in Tables 3-2 through 3-16 of WCAP-14575-A. In the LRA, SCE&G indicates that the VCSNS Inservice Inspection (ISI) Program involves monitoring of thermal transients. In RAI 4.3.1-3, the staff requested that the applicant discuss how the ISI Program addresses the components labeled I-M and I-RA in Tables 3-2 through 3-16 of WCAP-14575-A.

The applicant’s June 12, 2003, response indicated that the VCSNS TFMP manages the thermal fatigue of ASME Class 1 components. The staff review of the applicant’s response to RAI 4.3.1-1 indicated that the applicant’s TFMP monitors the design transients specified in the FSAR Table 5.2-2. Therefore, the staff finds the applicant’s response acceptable.

The Westinghouse Owners Group has issued the generic topical report WCAP-14574-A to address aging management of pressurizers. The staff’s review of WCAP-14574-A identified a number of issues that should be addressed on a plant-specific basis. Renewal Applicant Action Item 1 requests the applicant to demonstrate that the pressurizer subcomponent CUFs remain below 1.0 for the period of extended operation. Table 2-10 of WCAP-14574-A indicates that the ASME Section III Class 1 fatigue CUF criterion could be exceeded at several pressurizer subcomponent locations during the period of extended operation. WCAP-14574-A also

identified recent unanticipated transients that were not considered in the original ASME Section III Class 1 fatigue analyses, including inflow/outflow thermal transients. In RAI 4.3.1-4, the staff requested that the applicant provide the following information:

- Confirm that the additional transients discussed in WCAP-14574-A, not considered in the original design, have been addressed at VCSNS.
- Show the ASME Section III Class 1 CLB CUFs for the applicable sub-components of the VCSNS pressurizer specified in Table 2-10 of WCAP-14574-A and the corresponding CUFs for the extended period of operation.
- Discuss the impact of the environmental fatigue correlations provided in NUREG/CR-6583, “Effects of LWR Coolant Environments on Fatigue Design Curves of Carbon and Low-Alloy Steels,” and NUREG/CR-5704, “Effects of LWR Coolant Environments on Fatigue Design Curves of Austenitic Stainless Steels,” on the above results.

The applicant’s June 12, 2003, response indicated that the fatigue data for the pressurizer components was included in its response to RAI 4.3.1-1. As discussed previously, the fatigue accumulation at the surge line indicates that the design fatigue usage limit may be exceeded prior to the end of the period of extended operation. The applicant further indicated that changes were made to the operating procedure to slow the fatigue accumulation on the pressurizer surge nozzle. The applicant committed to perform a further evaluation of the pressurizer surge line nozzle for the impact of environmental fatigue prior to the period of extended operation. The staff finds the applicant’s commitment for further evaluation of the surge nozzle acceptable. The applicant has not provided the CUFs for the subcomponents listed in Table 2-10 of WCAP-14574-A or discussed the impact of the environmental fatigue correlations on these subcomponents. Therefore, the staff concludes there is a possibility that all components listed in Table 2-10 of WCAP-14574-A could exceed the fatigue usage limit during the period of extended operation when environmental fatigue effects are considered. The staff review of previous LRAs of Westinghouse facilities has found that the pressurizer surge line nozzle is the most limiting fatigue location for the pressurizer subcomponents.

The staff concludes that the pressurizer surge line nozzle is an acceptable sample component location for assessing the impact of environmental fatigue on pressurizer components. The applicant has committed to perform an evaluation of this component, including environmental fatigue effects, prior to the period of extended operation. If the applicant’s evaluation of the surge line nozzle for environmental effects indicates that additional actions are required to manage its fatigue usage during the period of extended operation, then the applicant should evaluate the remaining pressurizer components for the effects of environmental fatigue as part of its corrective action. The staff notes that this position is consistent with the staff position taken during the license renewal review of other facilities with Westinghouse pressurizers.

The applicant indicates that the Thermal Fatigue Monitoring Program will continue during the period of extended operation and will assure that design cycle limits are not exceeded. The applicant’s Thermal Fatigue Monitoring Program tracks transients and cycles of RCS components that have explicit design transient cycles to assure that these components remain within their design basis. Generic Safety Issue (GSI)-166, "Adequacy of the Fatigue Life of Metal Components,” raised concerns regarding the conservatism of the fatigue curves used in the design of the RCS components. Although GSI-166 was resolved for the current 40-year

design life of operating components, the staff identified GSI-190, "Fatigue Evaluation of Metal Components for 60-year Plant Life," to address license renewal. The NRC closed GSI-190 in December 1999, concluding:

> The results of the probabilistic analyses, along with the sensitivity studies performed, the iterations with industry (NEI and EPRI), and the different approaches available to the licensees to mange the effects of aging, lead to the conclusion that no generic regulatory action is required, and that GSI-190 is closed. This conclusion is based primarily on the negligible calculated increases in core damage frequency in going from 40 to 60 year lives. However, the calculations supporting resolution of this issue, which included consideration of environmental effects, and the nature of age-related degradation indicate the potential for an increase in the frequency of pipe breaks as plants continue to operate. Thus, the staff concludes that, consistent with existing requirements in 10 CFR 54.21, licensees should address the effects of coolant environment on component fatigue life as aging management programs are formulated in support of license renewal.

Section 4.3.1 of the LRA discusses the VCSNS Thermal Fatigue Monitoring Program. The discussion indicated that the program is equivalent to the program described in Section X.M1 of NUREG-1801. The discussion also indicated that the program will be enhanced to incorporate new guidance in EPRI report, "Materials Reliability Program Guidelines for Addressing Fatigue Environmental Effects in a License Renewal Application (MRP-47)." EPRI MRP-47 was submitted to the staff for review by Nuclear Energy Institute (NEI) by a letter dated July 31, 2001. By letter dated November 15, 2002, NEI requested that the staff place the review of EPRI MRP-47 on hold. As a consequence, the staff has not endorsed the guidelines in EPRI MRP-47. In order to meet the program described in NUREG-1801, the evaluation of the reactor water environmental effects should address the fatigue sensitive component locations identified in NUREG/CR-6260, "Application of NUREG/CR-5999 Interim Fatigue Curves to Selected Nuclear Power Plant Components." In RAI 4.3.1-5, the staff requested that the applicant provide the following additional information regarding the evaluation of reactor water environmental effects:

- Confirm that the environmental fatigue correlations contained in NUREG/CR-6583, "Effects of LWR Coolant Environments on Fatigue Design Curves of Carbon and Low-Alloy Steels," and NUREG/CR-5704, "Effects of LWR Coolant Environments on Fatigue on Fatigue Design Curves of Austenitic Stainless Steels," will be used in the evaluation.

- Describe any enhancements to the Thermal Fatigue Monitoring Program resulting from the guidance provided in EPRI Report MRP-47 and provide the technical justification for these enhancements.

- Provide the design basis usage factors for each of the six component locations listed in NUREG/CR-6260. Identify the transients that are significant contributors to the CUF at these locations.

In its June 12, 2003, response, the applicant committed to evaluate the environmental effects on the components listed in NUREG/CR-6260 prior to the period of extended operation. The applicant confirmed that the environmental fatigue correlations in NUREG/CR-6583 and NUREG/CR-5704 will be used in the evaluations. Although the applicant indicated that NUREG/CR-6260 locations applicable to VCSNS will be evaluated prior to the period of extended operation, the applicant did not provide the design usage factors for these locations. Consequently, the staff concludes there is a possibility that all the applicable components listed in NUREG/CR-6260 could exceed the fatigue usage limit during the period of extended

operation when environmental fatigue effects are considered. If the applicant's evaluation indicates that the fatigue usage limit for these components could be exceeded during the period of extended operation, then the applicant must take appropriate corrective actions in accordance with its Thermal Fatigue Monitoring Program. In accordance with GALL program X.M1, acceptable corrective actions include: a more rigorous analysis of the component to demonstrate that the design code limit will not be exceeded; repair, or replace part of the component. In addition, since the Thermal Fatigue Monitoring Program monitors the fatigue usage of a sample of critical components, the applicant's corrective actions may involve the evaluation of additional components for environmental fatigue effects.

The applicant is required to complete the TLAA evaluation prior to the period of extended operation. Therefore, the staff finds the applicant's commitment to evaluate the applicable components listed in NUREG/CR-6260 as discussed in the preceding paragraph acceptable.

Section 4.3.2 of the LRA addresses ASME Section III, Class 2 and 3 piping fatigue. The LRA indicates that the post-accident and nuclear sampling systems at VCSNS could approach the 7,000 cycle limit during the period of extended operation. In RAI 4.3.2-1, the staff requested that the applicant provide the material, the maximum calculated stress range, and the allowable stress limit at the bounding location for each of these systems.

The applicant's June 12, 2003, response indicated that a specific stress analysis was not performed for nuclear sampling system. The system was designed to criteria developed to satisfy the ASME stress limits. The applicant reiterated its previous position that it would administratively limit the use of the system such that the number of cycles will not exceed the 7,000 limit during the period of extended operation.

The applicant provided an FSAR supplement description of the TFMP in Section A18.2.37 of the LRA and FSAR supplement description of its TLAA evaluation for metal fatigue Section 18.3.2 of the LRA. By letter dated September 24, 2003, the applicant provided revised FSAR supplement descriptions that included its commitments for further evaluation of environmental fatigue and its commitment to administratively control the use of the nuclear sampling system. The staff finds that the applicant has provided an adequate description of the metal fatigue TLAA in the FSAR supplement.

4.3.3 Conclusions

The staff has reviewed the applicant's metal fatigue TLAA and concludes that the applicant's actions and commitments satisfy the requirements of 10 CFR 54.21(c)(1)(iii).

The staff has also reviewed the FSAR Supplement for the TLAA and finds that the FSAR Supplement contains an adequate description of the metal fatigue TLAA to satisfy 10 CFR 54.21(d).

4.4 Environmental Qualification of Electrical Equipment

The aging (or qualified life) analysis for electrical components, included as part of the Environmental Qualification Program required by 10 CFR 50.49, that involve time-limited assumptions as defined by the current operating term for the VCSNS (i.e., 40 years), meets the

10 CFR 54.3 definition for TLAA. The Environmental Qualification Program's aging evaluation for electrical components is thus considered a TLAA for license renewal. The Environmental Qualification Program, together with other plant programs/processes, has been evaluated, pursuant to 10 CFR 54.21(c)(1)(iii), to determine if they will adequately manage the effects of aging on the intended function(s) of electrical components for the period of extended operation.

In LRA Section 4.4, "Environmental Qualification of Electrical Equipment," the applicant describes the technical bases and justification for why the VCSNS Environmental Qualification Program, together with other plant programs/processes, adequately manages the effects of aging on the intended function(s) of electrical components for the period of extended operation. The staff reviewed this section of the LRA to determine whether the applicant had demonstrated that the effects of aging on the intended function(s) of electrical components will be adequately managed, through the VCSNS Environmental Qualification Program, together with other plant programs/processes, during the period of extended operation as required by 10 CFR 54.21(c)(1)(iii).

4.4.1 Summary of Technical Information in the Application

The NRC has established nuclear station environmental qualification (EQ) requirements in 10 CFR Part 50, Appendix A, Criterion 4, and 10 CFR 50.49. As required by 10 CFR 50.49, an Environmental Qualification Program must be established to demonstrate that certain electrical components located in harsh plant environments (that is, those areas of the plant that could be subject to the harsh environmental effects of a loss-of-coolant accident (LOCA), high energy line breaks (HELBs) or post-LOCA radiation) are qualified to perform their safety function in those harsh environments after the effects of inservice aging. This section also requires that the effects of significant aging mechanisms be addressed as part of environmental qualification.

All operating plants must meet the requirements of 10 CFR 50.49 for certain electrical components important to safety. This section defines the scope of components to be included. It also requires the preparation and maintenance of a list of in-scope components, and requires the preparation and maintenance of a qualification file that includes component performance specifications, electrical characteristics and the environmental conditions to which the components could be subjected. 10 CFR 50.49(e)(5) contains provisions for aging that require, in part, consideration of all significant types of aging degradation that can affect component functional capability. 10 CFR 50.49(e)(5) also requires replacement or refurbishment of components not qualified for the current license term prior to the end of designated life, unless additional life is established through ongoing qualification. Four methods of demonstrating qualification for aging and accident conditions are established in 10 CFR 50.49(f). Sections 10 CFR 50.49(k) and (l) permits different qualification criteria to apply based on plant and component vintage. Supplemental EQ regulatory guidance for compliance with these different qualification criteria is provided in the Division of Operating Reactors (DOR) Guidelines, Guidelines for Evaluating Environmental Qualification of Class 1E Electrical Equipment in Operating Reactors; NUREG-0588, Interim Staff Position on Environmental Qualification of Safety-Related Electrical Equipment; and RG 1.89, Rev. 1, Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants. Compliance with 10 CFR 50.49 provides reasonable assurance that the component can perform its intended functions during accident conditions after experiencing the effects of inservice aging.

Environmental Qualification Programs manage component thermal, radiation, and cyclical aging through the use of aging evaluations based on 10 CFR 50.49(f) qualification methods. As required by 10 CFR 50.49, EQ components not qualified for the current license term are to be refurbished, replaced, or have their qualification extended prior to reaching the aging limits established in the evaluation. Aging evaluations for EQ components that specify a qualification of at least 40 years are considered TLAAs for license renewal.

Under 10 CFR 54.21(c)(1)(iii), plant EQ programs, which implements the requirements of 10 CFR 50.49 (as further defined and clarified by the DOR Guidelines, NUREG-0588, and RG 1.89, Rev. 1), are viewed as an AMP for license renewal. Re-analysis of an aging evaluation to extend the qualification of components under 10 CFR 50.49(e) is performed on a routine basis as part of an EQ Program. Important attributes for the re-analysis of an aging evaluation include analytical methods, data collection and reduction methods, the underlying assumptions, the acceptance criteria, and corrective actions (if acceptance criteria are not met).

The re-analysis of an aging evaluation is normally performed to extend the qualification by reducing excess conservatism incorporated in the prior evaluation. Re-analysis of an aging evaluation to extend the qualification of a component is performed pursuant to 10 CFR 50.49(e) as part of an EQ Program. While a component life limiting condition may be due to thermal, radiation, or cyclical aging, the vast majority of component aging limits are based on thermal conditions. Conservatism may exist in aging evaluation parameters, such as the assumed ambient temperature of the component, an unrealistically low activation energy, or in the application of a component (de-energized versus energized). The re-analysis of an aging evaluation is documented according to the station's Quality Assurance Program requirements, which requires the verification of assumptions and conclusions. As already noted, important attributes of a re-analysis include analytical methods, data collection and reduction methods, underlying assumptions, acceptance criteria, and corrective actions (if acceptance criteria are not met). These attributes are discussed below.

Analytical Methods. The analytical methods used in the re-analysis of an aging evaluation are the same as those applied in the prior analysis. The Arrhenius methodology is an acceptable thermal model for reaction rate and thermal aging evaluation. The analytical method used for radiation aging evaluations is to demonstrate qualification for the total integrated dose via test. The total integrated does is the normal operational environmental dose plus the projected accident dose. For license renewal, it is acceptable to establish a 60-year normal operational radiation dose by taking the 40-year dose previously established and multiplying this value by 1.5. The result is added to the postulated accident dose to obtain a 60-year total integrated dose. For cyclical aging evaluations, a similar methodology is acceptable. Other methods may be justified on a case-by-case basis.

Data Collection & Reduction Methods. Reducing excess conservatism in electrical component service conditions (i.e., temperature, radiation, number of cycles) used in the prior evaluations is the chief method used for re-analysis. Temperature data used in an aging analysis is typically conservative and based on plant design temperatures. Actual plant operating temperature data is typically less than design values. Actual plant operating data may be obtained from temperature monitors specifically installed for EQ measurements, data taken by operators during rounds, or other temperature monitors in place in the plant.

Underlying Assumptions. EQ component aging evaluations typically contain sufficient conservatism to account for most environmental changes, which occur as a result of plant modifications and events. When unexpected adverse conditions are identified during operational or maintenance activities, the affected EQ component(s) is (are) evaluated and appropriate corrective actions are taken, which may include revisions to the qualification bases and conclusions.

Acceptance Criteria and Corrective Action. The re-analysis of an aging evaluation could extend the qualification of a subject component. If the qualification cannot be extended by re-analysis, the component is to be refurbished, replaced, or requalified prior to the expiration of the current qualification. The timing of the re-analysis must permit sufficient time to refurbish, replace, or requalify the component if the re-analysis effort is unsuccessful.

In addition to these important attributes for re-analysis of the aging evaluation, the VCSNS Environmental Qualification Program includes the attributes described below:

<u>Environmental Qualification Program</u>

[Scope] EQ Programs apply to certain electrical components that are important to safety and could be exposed to harsh environment accident conditions, as defined in 10 CFR 50.49.

[Preventive Actions] 10 CFR 50.49 does not require actions that prevent aging effects. EQ Program actions that could be viewed as preventive actions include (a) establishing the component service condition tolerance and aging limits (for example, qualified life or condition limit); and (b) where applicable, requiring specific installation, inspection, monitoring, or periodic maintenance actions to maintain component aging effects within the bounds of the qualification basis.

[Parameters Monitored or Inspected] EQ component qualified life is not based on condition or performance monitoring. However, pursuant to RG 1.89, Rev. 1, such monitoring programs are an acceptable basis to modify a qualified life through re-analysis. Monitoring or inspection of certain environmental conditions or component parameters may be used to ensure that the component is within the bounds of its qualification basis, or as a means to modify the qualified life.

[Detection of Aging Effects] 10 CFR 50.49 does not require the detection of aging effects for inservice components. Monitoring or inspection of certain environmental conditions or component parameters may be used to ensure that the component is within the bounds of its qualification basis, or as a means to modify the qualified life.

[Monitoring and Trending] 10 CFR 50.49 does not require monitoring and trending of component condition or performance parameters of inservice components to manage the effects of aging. EQ Program actions that could be viewed as monitoring include monitoring how long qualified components have been installed. Monitoring or inspection of certain environmental, condition, or component parameters may be used to ensure that a component is within the bounds of its qualification basis, or as a means to modify the qualification.

[Acceptance Criteria] 10 CFR 50.49 acceptance criteria are that an inservice EQ component is maintained within the bounds of its qualification basis, including (a) its established qualified life

and (b) continued qualification for the projected accident conditions. 10 CFR 50.49 requires refurbishment, replacement, or requalification prior to exceeding the qualified life of each installed device. When monitoring is used to modify a component qualified life, plant-specific acceptance criteria are established based on applicable 10 CFR 50.49(f) qualification methods.

[Corrective Action] If an EQ component is found to be outside the bounds of its qualification basis, corrective actions are implemented in accordance with the station's corrective action program. When unexpected adverse conditions are identified during operational or maintenance activities that affect the environment of a qualified component, the affected EQ component is evaluated and appropriate corrective actions are taken, which may include changes to the qualification bases and conclusions. When an emerging industry aging issue is identified that affects the qualification of an EQ component, the affected component is evaluated and appropriate corrective actions are taken, which may include changes to the qualification bases and conclusions.

[Confirmation Process] Confirmatory actions, as needed, are implemented as part of the station's corrective action program, pursuant to 10 CFR Part 50, Appendix B.

[Administrative Controls] EQ Programs are implemented through the use of station policy, directives, and procedures. EQ Programs will continue to comply with 10 CFR 50.49 throughout the renewal period, including development and maintenance of qualification documentation demonstrating reasonable assurance that a component can perform required functions during harsh accident conditions. EQ Program documents identify the applicable environmental conditions for the component locations. EQ Program qualification files are maintained at the plant site in an auditable form for the duration of the installed life of the component. EQ Program documentation is controlled under the station's quality assurance program.

[Operating Experience] EQ programs include consideration of operating experience, both at VCSNS and in the industry, to modify qualification bases and conclusions, including qualified life. This operating experience includes data on specific components and materials, data on aging limits, and new test data from manufacturers, industry groups, or the NRC. Compliance with 10 CFR 50.49 provides reasonable assurance that components can perform their intended functions during accident conditions after experiencing the effects of inservice aging.

Based on the above described attributes for re-analysis of the aging evaluation and EQ Program review, the applicant concluded that their EQ Program is capable of maintaining the qualification of components within the scope of 10 CFR 50.49. The EQ Program provides reasonable assurance that the aging effects will be managed such that the components subject to aging management review will continue to perform their intended functions consistent with the CLB for the period of extended operation.

4.4.2 Staff Evaluation

The staff reviewed the information in Section 4.4 of the LRA to determine whether the applicant has demonstrated that the effects of aging on the intended function(s) of electrical components will be adequately managed through their existing EQ Program, together with other plant

programs/processes, during the period of extended operation as required by 10 CFR 54.21(c)(1)(iii).

The applicant is required to have an EQ Program that meets the requirements of 10 CFR 50.49. The staff, therefore, agrees with the applicant's conclusion that their EQ Program, together with other plant programs/processes, will adequately manage the effects of aging on the intended function(s) of electrical components for the period of extended operation.

Generic Safety Issue -168, Environmental Qualification of Electrical Equipment

This GSI was developed to address environmental qualification of electrical equipment. By letter from C. Grimes (NRC staff) to D. Walters (NEI), dated June 2, 1998, the staff issued the following guidance to the industry:

- GSI-168 issues have not been identified to a point that a license renewal applicant can be reasonably expected to address these issues, specifically at this time.

- An acceptable approach is to provide a technical rationale demonstrating that the CLB for EQ will be maintained in the period of extended operation.

For the purpose of license renewal, there are three options for addressing issues associated with a GSI, as discussed in the statement of considerations (SOC) accompanying the final rule, 60 FR 22484, May 8, 1995:

- If the issue is resolved before the renewal application is submitted, the applicant can incorporate the resolution into the LRA.

- An applicant can submit a technical rationale that demonstrates that the CLB will be maintained until some later point in the period of extended operation, at which time one or more reasonable options would be available to adequately manage the effects of aging.

- An applicant can develop a plant-specific aging management that incorporates a resolution to the aging issue.

Pursuant to the requirements of 10 CFR Part 50, the staff will evaluate the applicant's compliance to the resolution of GSI-168 after its issuance and prior to the extended period of operation as part of 10 CFR 50.49. Resolution of GSI-168 pursuant to Part 50 meets the requirement of 10 CFR 54.21(c)(1)(iii) and is therefore considered acceptable.

Data Collection and Reduction Methods

With regard to the attribute, Data Collection and Reduction Methods, for re-analysis of the EQ aging evaluation, Section X.E1 of NUREG-1801 states –

> A representative number of temperature measurements are conservatively evaluated to establish the temperatures used in an aging evaluation. Plant temperature data may be used in an aging evaluation in different ways, such as (a) directly applying the plant temperature data in the evaluation or (b) using the plant temperature data to demonstrate conservatism when using plant design temperatures for an evaluation. Any changes to material activation energy values as part of a re-analysis are to be justified on a plant-specific basis. Similar methods of reducing excess conservatism in the component service conditions used in prior aging evaluations can be used for radiation and cyclical aging.

By letter dated March 28, 2003, the staff requested, in RAI 4.4-4, that the applicant clarify the extent to which the VCSNS EQ Program is consistent with this attribute. In its response dated June 12, 2003, the applicant stated the following:

> "The VCSNS EQ Program is fully consistent with this attribute contained within Section X.E1 of NUREG-1801."

Based on this response, the staff concluded that any change to a component's material activation energy value, if it is determined to be a necessary part of re-analysis pursuant to 10 CFR 54.21(c)(1)(iii), will be justified. The staff, through the VCSNS EQ Program, together with other plant programs/processes required by 10 CFR Part 50, will evaluate the applicant's justification for any change to a component's material activation energy value. The staff has concluded that the VCSNS EQ Program, together with other plant programs/processes required by 10 CFR Part 50, will adequately manage a component's aging during the period of extended operation as required by 10 CFR 54.21(c)(1)(iii). Therefore, justification pursuant to the requirements of 10 CFR Part 50 meets the requirements of 10 CFR 54.21(c)(1)(iii) and is considered acceptable.

Environmental Qualification Program Aging Process

Section 4.4 (3d paragraph) of the LRA indicates that each of the EQ documentation binders contains or references either a calculation of qualified life or an evaluation to justify a qualified life. By letter dated March 28, 2003, the staff requested, in RAI 4.4-1, that the applicant describe and justify the evaluation method utilized to justify a qualified life and to extend the qualified life from 40 to 60 years when the analytical EQ re-analysis method using calculations described in NUREG-1801 is not used. In its response dated June 12, 2003, the applicant stated the following:

> The Arrhenius methodology is the approved model used for calculating thermal qualified life of 10 CFR 50.49 equipment at VCSNS. As discussed in the LRA, Section 4.4.1.2, there may be some reduction of excess conservatism in service conditions from previous evaluations when sufficient information is available; however, the Arrhenius model is used in processing thermal qualified life determinations in accordance with approved Engineering Services calculation procedures.

Based on this response, the staff concluded that the applicant intends to utilize the analytical EQ re-analysis method using calculations described in NUREG-1801, for all cases, to justify extending the qualified life from 40 to 60 years; however, an evaluation method may be utilized if sufficient information is available to extend the qualified life from 40 to 60 years pursuant to the requirements of 10 CFR 50.49. The staff, through the VCSNS EQ Program, together with other plant programs/processes required by 10 CFR Part 50, will evaluate the applicant's evaluation method and information for justifying the qualified life extension. The staff has concluded that the VCSNS EQ Program, together with other plant programs/processes required by 10 CFR Part 50, will adequately manage a component's aging during the period of extended operation as required by 10 CFR 54.21(c)(1)(iii). Therefore, utilization of an evaluation method for extending qualified life pursuant to the requirements of 10 CFR Part 50 meets the requirements of 10 CFR 54.21(c)(1)(iii) and is considered acceptable.

Electrical Penetration Assemblies

By letter dated March 28, 2003, the staff requested, in RAI 4.4-3, that the applicant explain why (and to what extent) electrical penetration assemblies are not subject to aging (or qualified life)

requirements of 10 CFR 50.49. In its response dated June 12, 2003, the applicant stated the following:

> All electrical penetrations are included within the VCSNS Harsh EQ Program and meet the requirements of 10 CFR 50.49. All VCSNS electrical penetrations are subject to a TLAA. Non-Class 1E electrical penetrations were previously conservatively listed as requiring an aging management review because of their non-Class 1E status [Reference LRA 3.6.1.4]. The Aging management review is not required as these electrical penetrations have a qualified life that is administratively controlled within the EQ Program, are handled the same as class 1E penetrations, and are screened out in 54.21(a)(1)(ii).
>
> Although the non-1E electrical penetrations are covered within the EQ Program as a TLAA, the EQ Program does not include the non-1E cables leading up to the electrical penetrations, the splices or connections inside and outside the RB. These non-EQ components will be included in the Cables and Connections Aging Management Program.

Based on this response, the staff concluded that those portions of electrical penetration assemblies included within the scope of VCSNS EQ Program are subject to a TLAA. Therefore, these portions will be adequately managed, through the VCSNS EQ Program, together with other plant programs/processes, during the period of extended operation as required by 10 CFR 54.21(c)(1)(iii) and are considered acceptable. Non-1E cable leading up to the electrical penetrations and splices or connections inside and outside the reactor building are not considered part of the assemblies and have not been included in the VCSNS EQ Program. These are subject to an aging management review (AMR) as required by 10 CFR 54.21(a)(1).

4.4.3 Conclusions

The staff has reviewed the information in Section 4.4 of the LRA. On the basis of this review, the staff concludes that the applicant has demonstrated that the effects of aging on the intended function(s) of electrical components, that meet the definition for TLAA as defined in 10 CFR 54.3, will be adequately managed during the period of extended operation as required by 10 CFR 54.21(c)(1)(iii). In addition, the staff concludes that the FSAR Supplement will contain a summary description of the programs and activities for the evaluation of TLAA for the period of extended operation as required by 10 CFR 54.21(d).

4.5 Concrete Containment Tendon Prestress

The prestressing tendons in prestressed concrete containments lose their prestressing forces with time due to creep and shrinkage of concrete, and relaxation of the prestressing steel. During the design phase, engineers estimate these losses to arrive at the end of operating life, normally 40 years. The operating experiences with the trend of prestressing forces indicate that the prestressing tendons can lose their prestressing forces at a rate higher than predicted due to sustained high temperature. Thus, it is necessary to perform TLAAs for the period of extended operation. The adequacy of the prestressing forces in prestressed concrete containments is reviewed for the period of extended operation.

4.5.1 Summary of Technical Information in the Application

The VCSNS reactor building has a prestressed containment consisting of hoop and vertical post-tensioned tendons in the shell wall and a three-way post-tensioned system in the dome. Section 4.5 of the LRA indicates that the VCSNS Tendon Surveillance Program is based on the proposed Rev. 3 of RG 1.35. Subsequently, RG 1.35, Rev. 3 was finalized. However, the LRA

states that the NRC accepted the VCSNS Tendon Surveillance Program based on the proposed Rev. 3 of RG 1.35.

LRA Section 4.5 indicates that programmatic controls are used to ensure that the reactor building tendons are capable of performing their design function. The LRA states that the reactor building tendons are a TLAA, and VCSNS will utilize 10 CFR 54.21(c)(1)—Option (iii) to demonstrate that the effects of aging on the intended function(s) will be adequately managed for the period of extended operation. The LRA also states that Chapter X.S1, "Concrete Containment Tendon Prestress", of NUREG-1801, applies to these facilities that adopt 10 CFR 54.21(c)(1)—Option (iii) for containment tendon prestress.

LRA Appendix B.3.3, Tendon Surveillance Program, states that the Tendon Surveillance Program is consistent with X.S1, "Concrete Containment Tendon Prestress", in NUREG-1801. A brief history of the Tendon Surveillance Program is provided which describes when the various tendon surveillance were performed and some of the significant observations. Several important observations noted in Appendix B.3.3 and Section 4.5 of the LRA are: (1) tendon wire relaxation force losses greater than predicted during design, (2) retensioning of vertical tendons were required because the tendon forces would be below the technical specifications minimum values prior to the following period surveillance, (3) VCSNS expects that future retensioning will be needed before 60 years of operation, and (4) substantial amount of water in-leakage into the auxiliary building tendon sump area has occurred.

4.5.2 Staff Evaluation

As reported in Appendix B.3.3.1 of the LRA, test results from the first three surveillances indicated that the wire relaxation force losses in the tendon system were greater than the force losses predicted during design (resulting in lower measured prestressing forces). Therefore, in June 1988, the predicted wire relaxation force losses were increased from 8.5 percent to 12.5 percent. Then in the fourth period (10th year) tendon surveillance, the vertical tendons were retensioned because the previous surveillance data indicated that the vertical tendon forces would be below the technical specifications minimum prior to the fifth period surveillance. Although the fifth period (15th year) and sixth period (20^{th} year) tendon surveillance have been completed, no information was provided regarding the comparison of the measured tendon forces to the predicted lower limit at the 15th and 20th year tendon surveillance. LRA Section 4.5 indicates that, based on trending data and results from previous surveillance, VCSNS does not currently expect the tendons to provide adequate prestress for 60 years without future retensioning of various members.

In order to make a reasonable assessment regarding the effectiveness of the TLAA, the staff requested, in RAI 4.5-1, that the applicant provide the following information:

(a) Based on the measurements collected to date, provide the plots of the measured lift-off forces and trend lines, along with the predicted lower limits and minimum required values for the three sets of tendons (vertical, horizontal, and dome). These curves should reflect the past retensioning of the tendons. Identify whether the guidance in Information Notice (IN) 99-10 is implemented.

(b) Provide a brief discussion regarding the reason why the tendon wire relaxation values were greater than those used in the design of the tendon system. Are there any unique characteristics of the VCSNS tendons or containment design that would cause this to occur? If known, describe operating experience at other plants where similar tendon behavior has occurred.

In its response to RAI 4.5-1, the applicant stated –

> (a) Plots of the measured lift-off forces and trend lines, along with the minimum required values for the three sets of tendons (vertical, horizontal, and dome) are provided in Attachment XII. Guidance of IN 99-10 has also been implemented at VCSNS.
>
> (b) Based on elongation tests performed at Leheigh University for VCSNS tendon wire samples, it was found that stress relaxation of the tendons was not linearly proportional to temperature as originally projected based on manufacturer data. Therefore, stress relaxation was increased from 8.5% to 12.5% based on these tests. SCE&G is not aware of any unique characteristics of the VCSNS tendons or containment design that would cause this to occur, nor operating experience of similar behavior.

The staff review of the plots of the measured lift-off forces and trend lines, and the comparison to the minimum required values for the vertical, horizontal, and dome tendons, demonstrate that the approach being used is consistent with the TLAA AMP X.S1, Tendon Surveillance Program, identified in NUREG-1801. On this basis, the TLAA for concrete containment tendon prestress at VCSNS is in accordance with 10 CFR 54.21(c)(1)—Option (iii). Conformance to the guidance of IN 99-10 has been confirmed by VCSNS.

A description was provided by VCSNS which explains why the tendon wire relaxation values, greater than those used in design, occurred at VCSNS. Regardless of the cause, the staff concludes that this aging effect will be adequately managed by implementation of the VCSNS Tendon Surveillance Program.

4.5.3 Conclusions

On the basis of its review, the staff concludes that the applicant has provided an acceptable demonstration, pursuant to 10 CFR 54.21(c)(1)(iii), that the effects of aging on the intended function(s) will be adequately managed for the period of extended operation for the concrete containment tendon prestress TLAA. Therefore the staff has reasonable assurance that the safety margins established and maintained during the current operating term will be maintained during the period of extended operation, as required by 10 CFR 54.21(c)(1)(iii).

4.6 Containment (Reactor Building) Liner Plate, Metal Containment, and Penetration Fatigue Analysis

4.6.1 Containment (reactor building) Liner

4.6.1.1 Summary of Technical Information in the Application

The applicant stated that the reactor building liner at VCSNS provides an essentially leak-tight membrane on the inside face of the prestressed concrete reactor building that is designed to contain airborne radioactive particles and gases due to postulated accidents, such as a LOCA.

The liner has been designed to remain within ASME Boiler and Pressure Vessels, Section III, stress limits.

The reactor building liner was designed under ASME Section III, Subsection NE, 1974, with all applicable addenda. The requirements for liner fatigue analysis were evaluated in accordance with Paragraph NE-3131. The applicant performed the necessary comparisons and calculations for 40-year operation and concluded that the liner met the criteria of NE-3222.4(d) for exemption of fatigue analysis. This calculation was evaluated for 60-year operation, and the applicant concluded that the liner also met the criteria of NE-3222.4(d) for the period of extended operation.

4.6.1.2 Staff Evaluation

The applicant stated that a fatigue analysis of the containment (reactor building) liner at VCSNS was not required, because the plant met the requirements of ASME Code Section III, NE-3222.4. The applicant provided the ASME Code calculation in support of its statement. The staff confirmed that the calculation showed the ASME Code rules for exemption of the fatigue analysis were satisfied. The staff notes that the applicant's results are consistent with the results of similar calculations reviewed by the staff for previous license renewal applications. Therefore, the staff finds that the applicant has demonstrated that the fatigue analysis of the liner is valid for the period of extended operation, in accordance with 10 CFR 54.21 (c)(1).

4.6.1.3 Conclusions

On the basis of its review, the staff concludes that the applicant has provided an acceptable demonstration that the containment liner stress TLAA has been projected to the end of the period of extended operation, in accordance with 10 CFR 54.21(c)(1)(ii). The staff also concludes that the FSAR Supplement contains an appropriate summary description of the containment liner stress TLAA evaluation for the period of extended operation, as reflected in the license condition. Therefore, the staff has reasonable assurance that the safety margins established and maintained in the containment liner stress TLAA during the current operating term will be maintained during the period of extended operation, as required by 10 CFR 54.21(c)(1).

4.6.2 Metal Containments

There are no plant-specific TLAAs for a metal containment at VCSNS, since this plant does not have a metal containment structure.

4.6.3 Containment (Reactor Building) Isolation

This section addresses isolation bellows fatigue, fracture toughness of the penetration materials, and effects of radiation.

4.6.3.1 Containment (Reactor Building) Isolation Bellows

4.6.3.1.1 Summary of Technical Information in the Application

Based on FSAR Section 6.2.6.2.1.1, Piping Penetrations and Spares, the applicant stated that cold piping penetrations are sealed inside and outside containment by flat plates, welded to both the end of the penetration sleeve and the process pipe. These plates serve to isolate the containment. Hot piping penetrations are also sealed inside containment by flat end plates, welded to both the end of the penetration sleeve and the process pipe. On the outside, hot penetrations are sealed by a single bellows, one end of which is attached to the penetration sleeve and the other end is attached to the process pipe. Since these penetrations do not use resilient or flexible seals, these penetrations do not require Type B leakage tests. The applicant also stated that the fatigue analysis of the penetration bellows do not meet either Criterion 4 or 5 of 10 CFR 54.3 for plant-specific TLAA because they are not credited in a safety determination and do not perform a containment isolation function.

4.6.3.1.2 Staff Evaluation

The staff concurs with the applicant's statement that the fatigue analysis of the bellows does not meet the criteria in 10 CFR 54.3 for a TLAA, because the bellows are not credited in a safety determination and do not perform a safety function. However, the applicant did not provide information regarding the classification and fatigue analyses of the other parts of the hot penetrations, such as liner plates, sleeves and end plates, which form part of the containment pressure boundary.

In RAI 4.6.1, the staff requested that the applicant provide justification for not evaluating the effects of hot process pipe thermal operating transients and other cyclic loads on potential fatigue of the liner, the hot penetrations, and the process piping at these locations.

The applicant stated in his response that the piping going through the penetrations is classified as Class 2 piping, analyzed under the rules of ASME Section III, Subsection NC, 1974. As shown in the FSAR Supplement, the penetrations are classified as Class MC, analyzed under the rules of ASME Section III, Subsection NE, 1974. In accordance with Subarticle NE-1120, the penetrations are classified in accordance with the piping to which they are attached. The penetrations, including the closure plates, were therefore designed and fabricated in accordance with the requirements for Class 2 components of Subsection NC.

For Class 2 piping, Subsection NC does not require an explicit fatigue analysis. Rather, the fatigue due to full range thermal and mechanical cycling loads is accounted for implicitly in the Class 2 design stress limits by the use of stress range reduction factors. At VCSNS, the chosen factor (1.0) assumes that all Class 2 piping will be subjected to at most 7,000 full thermal cycles of heat up and cool down from ambient to the pipe normal operating conditions. This is considerably larger than the expected number of full heat up and cool down cycles expected during the life of the plant, including the period of extended operation.

The applicant stated that the penetration sleeve forms a rigid anchor embedded within the concrete containment walls, while the process pipe is welded to the sleeve through the flat plates. The welds were therefore effectively evaluated for fatigue based on the Class 2 rules and found acceptable for 7,000 cycles. The sleeve is also welded to the liner through a thickened liner reinforcing plate. Since it rigidly embedded in the concrete shell, the effect of hot service pipe thermal cycling on this weld is minimal. Per Section 3.8.1.1.2.2(1) of the FSAR Supplement, the sleeve-liner weld falls within the jurisdiction of Subsection NE, and is therefore evaluated for fatigue according to Subsection NE rules for the liner plates. The applicant

stated, in paragraph 4.6.1.1 of the LRA, that the operating conditions on the liner satisfied the requirements for exemption of a fatigue analysis stated in NE-3222.4(d). The weld therefore also meets the requirements for exemption of a fatigue analysis, in accordance with the staff evaluation stated above in Section 4.6.1.2 of this safety evaluation.

4.6.3.1.3 Conclusions

On the basis of its review, the staff concludes that the applicant has provided an acceptable demonstration that the piping penetration flat plate fatigue TLAA has been projected to the end of the period of extended operation, in accordance with 10 CFR 54.21(c)(1)(i). Therefore the staff has reasonable assurance that the safety margins established and maintained in the containment piping penetration fatigue TLAAs during the current operating term will be maintained during the period of extended operation, as required by 10 CFR 54.21(c)(1)(ii).

4.6.3.2 Containment (Reactor Building) Isolation - Fracture Toughness and Effects of Radiation

4.6.3.2.1 Summary of Technical Information in the Application

The applicant stated that the FSAR and the corresponding NRC SER NUREG-0717 include statements regarding the life of materials used in the reactor building penetrations and the fracture toughness of the containment pressure boundary. FSAR Supplement Section 6.2.4.5 states that the materials for containment isolation system components were selected to perform their design function for 40 years based on an integrated radiation dose of 10^8 rads. All materials that come in contact with the reactor building spray solution are resistant to corrosion. However, the statement that components would perform their design function for 40 years was unsupported in that no analyses were identified that specifically calculated the design life. No TLAAs were therefore identified for these components.

The applicant evaluated the statements in NUREG-0717, regarding the NRC assessment of the ferritic materials used in the construction of the containment pressure boundary and its components, and concluded that the NRC had determined that the ferritic materials meet the appropriate requirements of the ASME Code, comply with GDC-51 “Fracture Prevention of Containment Pressure Boundary,” and behave in a nonbrittle manner.

4.6.3.2.2 Staff Evaluation

The staff concurs with the applicant that this section does not meet the criteria for a TLAA, since no analyses or calculations were identified that require revision for the time effects of radiation on containment isolation components.

4.6.3.2.3 Conclusions

The analysis of the reactor building containment isolation for fracture toughness and the effects of radiation do not meet the criteria stated in 10 CFR 54.3 for the definition of a TLAA, since no analyses or calculations have been identified that require revision for the time effects of radiation on containment isolation components.

4.7 Other Plant-Specific Time-Limited Aging Analyses

There are certain plant-specific safety analyses that may have been based on an explicitly assumed 40-year plant life and, therefore, may be TLAAs. Pursuant to 10 CFR 54.21(c)(1), a license renewal applicant is required to evaluate TLAAs, as defined in 10 CFR 54.3. License renewal reviews focus on the period of extended operation.

The applicant has identified four additional TLAAs for license renewal:

- reactor coolant pump flywheel
- leak-before-break analysis for resolution of USI A-2
- crane load cycle limit
- service water intake structure settlement

The staff's evaluation of these TLAAs is provided below.

4.7.1 Reactor Coolant Pump Flywheel

4.7.1.1 Summary of Technical Information in the Application

Section 4.7.1 of the LRA and Section 18.3.6.3 of Appendix A to the LRA address the concerns for fatigue crack initiation and growth in the VCSNS reactor coolant pump (RCP) flywheels. During normal operation, the RCP flywheel possesses sufficient kinetic energy to potentially produce high-energy missiles in the unlikely event of failure. The aging effect of concern is fatigue crack initiation in the flywheel bore keyway from stresses due to starting the motor. The applicant states that WCAP-14535A, Topical Report of Reactor Coolant Pump Flywheel Inspection Elimination, supports the elimination of RCP flywheel inspections, based on the insignificant increase in probability of failure achieved by inspections over a 60-year service life, the relatively robust nature of flywheels with respect to detectable flaws, and the likelihood that disassembly and reassembly for continued inspections presented the largest risk of causing flaws in the RCP flywheels. WCAP-14535A, which has been approved by the NRC, concludes that the crack growth for the postulated flaw over 60 years of operation is acceptable.

4.7.1.2 Staff Evaluation

The staff-approved version of WCAP-14535, "Topical Report of Reactor Coolant Pump Flywheel Inspection Elimination," was published as WCAP-14535A in November 1996. This report also includes the staff's RAIs and SER for WCAP-14535. The applicant states that WCAP-14535A allows the elimination of RCP flywheel inspections. However, the information presented in WCAP-15666, "Extension of Reactor Coolant Pump Motor Flywheel Examination," Rev. 0, Non-Proprietary Class 3, July 2001, contradicts the applicant's statement. According to WCAP-15666, the staff's SER, which is included in WCAP-14535A, does not allow total elimination of inspections. In addition, the applicant states that WCAP-14535A supports the elimination of RCP flywheel inspections based on the insignificant increase in probability achieved by inspections over a 60-year service life. However, according to WCAP-15666, the staff has stated in the SER that it had not reviewed the risk assessment discussion presented in WCAP-14535, but solely relied on the deterministic methodology to review the submittal.

The staff issued RAI 4.7.1-1, which requested the applicant discuss how WCAP-14535 is applicable to the VCSNS RCP flywheel and confirm whether VCSNS has submitted for staff review its assessment of the plant-specific applicability of WCAP-14535 for V.C. Summer. The RAI also requested that the applicant identify the material used to fabricate the flywheel and confirm whether the VCSNS flywheel belongs to a specific flywheel group as defined by WCAP-14535.

In response to RAI 4.7.1-1, in a letter dated June 12, 2003, the applicant submitted the following information. The applicant indicated that WCAP-14535A has not been previously docketed by VCSNS. The generic report has been docketed by Westinghouse and it is applicable to VCSNS. The VCSNS RCP flywheels are included in Group 3 of the WCAP classification. The WCAP classification is according to the geometric and physical characteristics of the flywheel including outer diameter, bore diameter, keyway radial length, pump and motor inertia, and material. Also, the VCSNS RCP flywheels are fabricated with SA 533B material. According to the SER for WCAP-14535, Group 3 flywheels satisfy the ductile fracture criterion, nonductile fracture criterion, and excessive deformation criterion of RG 1.14, "Reactor Coolant Pump Flywheel Integrity," 1971, Rev. 1, August 1975. VCSNS has conservatively treated the RCP flywheel as a TLAA due to the fatigue issues of that component, the WCAP, and previous applicants' submittals.

The regulatory position of RG 1.14 concerning inservice inspection (ISI) calls for an in-place ultrasonic volumetric examination of the areas of higher stress concentration at the bore and keyway at approximately 3-year intervals, and a surface examination of all exposed surfaces and complete ultrasonic volumetric examination at approximately 10-year intervals. Operating power plants have been inspecting their flywheels for over 20 years, and no flaws have been identified that affect flywheel integrity. Because of this inspection record and the concerns over high inspection costs and personnel radiation exposure, WCAP-14535 was submitted to demonstrate, through fracture mechanics analysis, that flywheel inspections can be eliminated without impairing plant safety. However, the staff does not accept the elimination of flywheel inspection. Instead, in the SER for WCAP-14535, the staff recommends that a licensee with Group 3 flywheels should either conduct a qualified in-place Ultrasonic Testing (UT) examination over the volume from the inner bore of the flywheel to the circle of one-half the outer radius, or conduct a surface examination of exposed surfaces defined by the volume of the disassembled flywheels once every 10 years. The applicant, in its response to RAI 4.7.1-1, states that it does not intend to eliminate the current 10-year inspection through the license renewal submittal. The staff finds the response acceptable because it is consistent with the staff position concerning the ISI of reactor coolant pump flywheels.

WCAP-14535-A contains a fatigue crack growth analysis as part of the integrity evaluation for the RCP flywheel. The estimated magnitude of fatigue crack growth during plant life was conservatively calculated based on an assumed initial radial crack length of 10% through the flywheel. The analysis assumed 6000 cycles of pump starts and stops for a 60-year plant life. Crack growth from postulated flaws in each flywheel was only a few mils. The existing analysis is valid for the period of extended operation because reaching 6000 starts in 60 years would require a pump start on average every 3.7 days, which is extremely conservative. Therefore, the findings of this analysis, which has been recently approved by the NRC, indicated that the crack growth for the postulated flaw over 60 years of operation is acceptable. The analysis in WCAP-14535A is applicable for 60 years of operation in accordance with 10 CFR 54.21(c)(1)(ii).

4.7.1.3 Conclusions

On the basis of its review, the staff concludes that the applicant has presented an acceptable demonstration, pursuant to 10 CFR 54.21(c)(1), that, for the RCP flywheel TLAA, the analyses will remain valid for the period of extended operation. The staff also concludes that the FSAR Supplement contains an appropriate summary description of the reactor coolant pump flywheel TLAA evaluation for the period of extended operation. Therefore, the staff has reasonable assurance that the safety margins established and maintained during the current operating term will be maintained during the period of extended operation, as required by 10 CFR 54.21(c)(1)(ii).

4.7.2 Leak-Before-Break Analysis

4.7.2.1 Summary of Technical Information in the Application

Section 4.7.2 of the LRA and Section 18.3.2.2 of Appendix A to the LRA address leak-before-break (LBB) analyses for the primary loop piping of the VCSNS RCS. Westinghouse tested and analyzed crack growth with the goal of eliminating RCS primary loop pipe breaks from plant design bases. The objective of the investigation was to determine whether a postulated crack, causing a leak, will grow to become unstable and lead to a full circumferential break when subjected to the worst possible combinations of plant loading, including the effects of safe-shutdown earthquake. The detailed evaluation showed that the reactor coolant piping is not subject to such unstable conditions under the worst combination of plant loading. The VCSNS LBB analyses consider the thermal aging of the CASS material of the piping as well as the fatigue transients that drive the flaw growth over the operating life of the plant. In a letter dated January 11, 1993, the NRC approved the VCSNS LBB analysis. VCSNS has recently updated its LBB analysis to account for the replacement of steam generator, power uprate, and the RCS A-hot leg repair.

The VCSNS LBB analysis is based on stainless steel at 40 years and needs to be revised to account for the period of extension. The applicant elects to utilize 10 CFR 54.21(c)(1)(ii) to develop a revised LBB analysis for the period of extended operation.

4.7.2.2 Staff Evaluation

The applicant states that the current VCSNS LBB analysis is for 40 years of operation and accounts for the replacement of steam generators, power uprate, and the RCS A-hot leg repair. As a result of the VCSNS event in which primary water stress corrosion cracking (PWSCC) was identified in an Inconel 82/182 main coolant loop-to-reactor pressure vessel weld, the NRC staff has become concerned about the impact of PWSCC on licensee LBB evaluations. NUREG-1061, Volume 3, "Report of the U.S. Nuclear Regulatory Commission Piping Review Committee, Evaluation of Potential for Pipe Breaks," which addresses the general methodology accepted by the NRC staff for demonstrating LBB behavior, stipulates that no active degradation mechanism may be present in a line which is under consideration for LBB. Draft Standard Review Plan 3.6.3, "Leak-Before-Break Evaluation Procedures," suggests that lines with potentially active degradation mechanisms may be considered for LBB approval provided that two mitigating actions/programs are in place to address the potential active degradation mechanism.

The NRC considers the resolution of the impact of PWSCC on existing LBB evaluations to be a 10 CFR Part 50, operating reactor issue. The NRC staff has previously addressed this issue with the industry's PWR Materials Reliability Program (MRP) and received an interim report from the MRP, "PWR Materials Reliability Program, Interim Alloy 600 Safety Assessment for U.S. PWR Plants (MRP-44), Part 1: Alloy 82/182 Pipe Butt Welds," dated April 2001, which attempted to provide a technical basis for addressing this issue. The NRC expects to receive a final version of the report, MRP-44, Part 1, from the MRP. Based on the information in the final MRP report and any additional, relevant information available to the NRC staff, the NRC will evaluate what actions or analyses, if any, may be required to confirm the continued applicability of existing licensee LBB evaluations.

Regarding the VCSNS LRA, the staff issued RAI 4.7.2-1, which requested that the applicant provide a licensee commitment which states that for the period of extended operation of VCSNS, it will implement actions or perform analyses, as deemed necessary by the NRC, to confirm continued applicability of existing VCSNS LBB evaluations. These actions or analyses will be consistent with those required to address the impact of PWSCC on existing LBB evaluations under 10 CFR Part 50 considerations. The RAI also requested that the applicant submit information about any mitigative actions (e.g., mechanical stress improvement) that may have taken place at VCSNS since submittal of the LRA to manage PWSCC cracks in Alloy 82/182 piping welds and confirm whether the future VCSNS LBB analysis will account for these mitigative actions. In response to RAI 4.7.2-1 in a letter dated June 12, 2003, the applicant confirms that the commitments made by VCSNS in response to the PWSCC cracking of the RCS piping will continue into the period of extended operation. The staff finds the applicant's response acceptable because the applicant will continue its commitments made in response to PWSCC cracking of RCS piping into the period of extended operation. The applicant also states that VCSNS has implemented mechanical stress improvement activities for the two hot leg nozzle-to-piping welds that were not repaired. The information associated with this effort was submitted to the NRC, and an SER dated October 1, 2002, from Karen R. Cotton to Stephen A. Byrne was issued. As discussed in this SER, the staff reviewed an analytical evaluation of applying the MSIP to the VCSNS reactor pressure vessel hot leg nozzle welds and agreed with the licensee's assertion that the driving force for the cracks has been either removed or greatly reduced. In its response to RAI 4.7.2-1, the applicant also states that because of the mechanical stress improvement activities, the LBB report did not need to be revised. The staff finds this response acceptable because the application of MSIP has eliminated or reduced the driving force for PWSCC cracks and, therefore, the applicant does not need to revise its LBB report. The applicant elects to utilize 10 CFR 54.21(c)(1)(ii) to develop in the future a revised LBB analysis for the period of extended operation. This is acceptable because the revised LBB analysis will be submitted for the staff review and approval.

4.7.2.3 Conclusions

On the basis of its review, the staff concludes that the applicant has provided an acceptable demonstration, pursuant to 10 CFR 54.21(c)(1)(ii), that, for the LBB TLAA, the LBB analyses will be revised to the end of the period of extended operation. The staff also concludes that the FSAR Supplement contains an appropriate summary description for the evaluation of LBB TLAA for the period of extended operation, as reflected in the license condition. Therefore the staff has reasonable assurance that the safety margins established and maintained during the

current operating term will be maintained during the period of extended operation, as required by 10 CFR 54.21(c)(1).

4.7.3 Crane Load Cycle Limit

4.7.3.1 Summary of Technical Information in The Application

The applicant identified cranes and associated crane supports as TLAAs because they could affect irradiated fuel during refueling operations. The following cranes meet the criterion.

- Reactor Building Polar Crane
- Spent Fuel Cask Handling Crane
- Fuel Handling Machine (Spent Fuel Pit Bridge and Hoist)
- Refueling Machine (Reactor Cavity Manipulator Crane)

The applicant states that the Crane Manufacturers Association of America (CMAA) Specification No. 70 (CMAA 70) classifies these cranes as Class “A” cranes**.** CMAA 70 Class A is defined in paragraph 2.2 as “cranes which may be used in installations such as power-houses, public utilities, turbine rooms, motor rooms and transformer stations where precise handling of equipment at low speeds with long idle periods between lifts are required. Capacity loads may be handled for initial installation of equipment or infrequent maintenance.”

The current version of CMAA 70, Section 2.8, “Crane Service in Terms of Load Class and Load Cycles” states that Class A Cranes should be designed for 20,000 to 100,000 load cycles. However, according to the applicant, the version of CMAA 70 in effect during VCSNS construction lists 20,000 to 200,000 load cycles. Since the cranes listed above were designed to the earlier CMAA 70 requirements according to the applicant, the higher load cycle limits apply. Cranes and crane supports are considered a TLAA because they satisfy the six criteria for a TLAA defined in 10 CFR 54.3.

The applicant states that the reactor building polar crane, including the bridge girders, end trucks, and trolley, were originally designed for construction loads of 360 tons. A seismic analysis was performed for the maximum, nonconstruction load of 150 tons. Since construction, the polar crane was only used for capacity lifts during the VCSNS steam generator replacement project. The steam generator lifts were rated capacity lifts of 354 tons. Lifts of the lower internals (135 tons), vessel head (125 tons), upper internals (52 tons), RCPs, missile shields, and other routine refueling operation lifts are commonly done during an outage and do not exceed the seismic load limit of 150 tons. According to the applicant, lifts of 150 tons or less do not qualify as capacity lifts since they are far less than the crane’s rated capacity of 360 tons.

The applicant has provided an estimate of the projected number of lifts for the polar crane during a 60-year period of operation. This estimate has been shown to be well within the CMAA 70 limit of 200,000 cycles. Therefore, the applicant concludes that the crane is adequately analyzed and designed for fatigue through the term of extended operation.

The spent fuel cask handling crane is rated for 125 tons. The projected number of fuel cask

lifts for this crane also has been estimated by the applicant to be far less than 200,000 CMAA 70 limit over a 60-year period. Therefore, according to the applicant, the spent fuel cask handling crane is adequate for the period of extended operation.

The fuel handling machines consist of a fuel handling machine (spent fuel pit bridge and hoist) and refueling machine (reactor cavity manipulator crane).

The refueling machine and fuel handling machine lift load consist of the combination of a spent fuel or new fuel assembly and handling tool. The maximum load weighs approximately 2500 pounds. The refueling machine crane is rated for 3000 pounds.

The fuel handling machine hoist is designed with a margin of two for lifts. The hoist capacity is 4000 pounds while the combined weight of the fuel assemble with a rod cluster control assembly and the spent fuel assembly handling tool is approximately 2000 pounds. The fuel handling machine structure is designed to commercial standards and also analyzed to the requirements of Section III, Appendix XVII of the ASME Boiler and Pressure Vessel Code, and has the margins included in the allowable stresses of the Code.

As with the other cranes discussed above, the applicant has provided an estimate to demonstrate that the total number of loading cycles during 60 years of operation would be far less than the originally designed 200,000 lift cycles based on the CMAA 70 requirements. Therefore the applicant has elected to utilize 10 CFR 54.21(c)(1) – Option (i) to demonstrate that the fuel handling machines and reactor building polar crane are adequately analyzed for the period of extended operation.

4.7.3.2 Staff Evaluation

The method of review applicable to the crane cyclic load limit TLAA involves (1) reviewing the existing 40-year design basis to determine the number of load cycles considered in the design of each of the cranes in the scope of license renewal, and (2) developing 60-year projections for load cycles for each of the cranes in the scope of license renewal and compare them to the number of design cycles for 40 years.

Section 4.7.3.1 of the LRA addresses the reactor building polar crane. The LRA states that, "The number of lifts was based on one lift for each replaced (old) D-3 steam generator and one for each replacement (new) Delta 75 steam generator, which yields a total of six capacity lifts. Imposing an extremely conservative safety factor of five yields 30 lifts. Assuming a similar number of lifts during initial construction yields an estimate of 60 lifts. In addition, the crane lifted the reactor (330 tons) during construction."   The staff concurs with the applicant's estimate of 61 lifts and finds it to be less than the CMAA 70 limit of 200,000 cycles by several orders of magnitude. Therefore, the staff finds that the reactor building polar crane was adequately evaluated for the period of extended operation.

The projected number of fuel cask lifts for the spent fuel cask handling crane is based on the assumption that 70 fuel bundles are replaced every 18 months for 60 years, in addition to the original 157 bundles. It is also assumed that each bundle is loaded individually into separate casks, and each cask lifted twice. This adds up to a total number of approximately 10,000 lifts. The staff concurs with the applicant's assessment and finds it to be reasonable and conservative. Since it is within the CMAA-70 limit for the crane by a wide margin, the staff finds

that the spent fuel cask handling crane has been adequately evaluated for the period of extended operation.

The fuel handling cranes are assumed to perform 400 lifts each refueling cycle for each machine. This consists of 70 loadings of new fuel assemblies, a full core offload of 157 fuel assemblies, a full core reload of 157 fuel assemblies, and 16 miscellaneous fuel assembly shuffles. With 40 refueling cycles in 60 years, this adds up to a total of approximately 16,000 cycles in 60 years. The staff finds the applicant's estimate reasonable. The fuel handling cranes were analyzed for up to 200,000 cycles of maximum load based on the crane manufacturer's calculations and CMAA Specification No. 70. Since a conservative estimate of load cycles is far less than the design limit in CMAA 70 (as well as the 100,000 cycles limit in the current version of CMAA 70), the staff finds that the fuel handling cranes were adequately evaluated for the period of extended operation.

4.7.3.3 Conclusions

On the basis of its review, the staff concludes that the applicant has provided an acceptable demonstration, pursuant to 10 CFR 54.21(c)(1), that for the crane cycle load limit TLAA, the analyses have been projected to the end of the period of extended operation. The staff also concludes that the FSAR Supplement contains an appropriate summary description of the metal fatigue TLAA evaluation for the period of extended operation, as reflected in the license condition. Therefore the staff has reasonable assurance that the safety margins established and maintained during the current operating term will be maintained during the period of extended operation, as required by 10 CFR 54.21(c)(1).

4.7.4 Service Water Intake Structure Settlement

4.7.4.1 Summary of Technical Information in the Application

The service water intake structure (SWIS) at VCSNS is a reinforced rectangular box culvert with two reinforced concrete wing walls at the intake end. The SWIS is mostly buried within the west embankment and the portion that is not covered by soil is submerged within the service water pond. The function of the SWIS is to draw water from the service pond into the service water pumphouse (SWPH).

LRA Section 4.7.4 indicated that excessive nonuniform settlement of the intake structure occurred during construction which caused considerable cracking. This settlement was analyzed in a SWPH calculation, which was originally based on a plant design life of 40 years. Since this issue meets all six criteria in 10 CFR 54.3, the applicant concluded that SWIS settlement is a TLAA for VCSNS.

The LRA indicated that the VCSNS calculation was revised to account for the period of extended operation (60 years). The applicant concluded that this revision demonstrated that the expected settlement is acceptable for the period of extended operation. Therefore, VCSNS incorporated Option (ii) to satisfy 10 CFR 54.21(c)(1) for the SWIS settlement.

4.7.4.2 Staff Evaluation

The staff concurs that SWIS settlement is a TLAA for VCSNS. In addition, the staff finds it acceptable for the applicant to address SWIS settlement using Option (ii) of 10 CFR 54.21(c)(1) by revising existing calculations to account for the period of extended operation to 60 years. The staff notes that no description of the analytical methodology or summary of the results utilized in the TLAA calculation have been provided in the LRA. During the AMR inspection (August 18-22, 2003; IR 50-395/03-08, dated September 29, 2003), the staff reviewed numerical calculation demonstrating that changing from a 40-year operating life to a 60-year operating life has no impact on the conclusions reached in the original calculation, namely that maximum predicted sublayer fill compaction will be about 2 inches.

VCSNS has committed in the LRA to a Service Water Structures Survey Monitoring Program and an Under Water Inspection Program (SWIS and SWPH). The Service Water Structures Survey Monitoring Program is an AMP which monitors any vertical or horizontal movement associated with settlement of the SWIS, SWPH, electrical duct banks, and service water intake line “A.” The survey monitoring data is reviewed by VCSNS Design Engineering to ensure that settlements remain within established criteria. The Underwater Inspection Program (SWIS and SWPH) is an AMP which visually inspects the interior length of the intake tunnel, survey monitoring masts, trash racks, access ladder and east end wing walls. The main reason for inspecting the SWIS is to measure/monitor cracks (old and new) in the concrete structure that originated due to earlier settlement. The staff evaluations of the Service Water Structures Survey Monitoring Program and the Under water Inspection Program (SWIS and SWPH) as AMPs are presented in SER Sections 3.5.2.3.10 and 3.5.2.3.11, respectively.

The staff considers the VCSNS Service Water Intake Structure Settlement TLAA performed in accordance with Option (ii) of 10 CFR 54.21(c)(1) to be acceptable.

4.7.4.3 Conclusions

On the basis of its review, the staff concludes that the applicant has provided an acceptable demonstration, pursuant to 10 CFR 54.21(c)(1)(ii), that, for the Service Water Intake Structure Settlement TLAA, the analyses have been projected to the end of the period of extended operation. The staff also concludes that the FSAR Supplement contains an appropriate summary description of the Service Water Intake Structure Settlement TLAA evaluation for the period of extended operation, as reflected in the license condition. Therefore, the staff has reasonable assurance that the safety margins established and maintained during the current operating term will be maintained during the period of extended operation, as required by 10 CFR 54.21(c)(1).

4.8 Conclusion for Time-Limited Aging Analyses

On the basis of its review of the TLAAs, the staff concludes that actions have been identified and have been or will be taken with respect to TLAAs that have been identified to require review under 10 CFR 54.21(c) such that there is reasonable assurance that the activities authorized by a renewed license will continue to be conducted in accordance with the CLB, as required by 10 CFR 54.29(a).

5 REVIEW BY THE ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

The Advisory Committee on Reactor Safeguards (ACRS) will review the 10 CFR Part 54 portion of the V.C. Summer license renewal application. The ACRS Subcommittee on Plant License Renewal will continue its detailed review of the LRA after this report is issued. South Carolina Electric and Gas Company (SCE&G), and the staff will meet with the subcommittee committee to discuss issues associated with the review of the LRA. After the ACRS completes its review of the V.C. Summer LRA and SER, the full committee will issue a report discussing the results of its review. This report will be included in an update to this SER. The staff will address any issues and concerns identified in that report.

THIS PAGE IS INTENTIONALLY LEFT BLANK

6 CONCLUSIONS

The staff reviewed the V.C. Summer license renewal application in accordance with Commission regulations and NUREG-1800, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants," dated July, 2001. In accordance with 10 CFR 54.29, the staff identifies the standards for issuance of a renewed license.

On the basis of its evaluation of the application as discussed above, the staff has determined that the requirements of 10 CFR 54.29 have been met.

The staff notes the requirements of Subpart A of 10 CFR Part 51 are documented in NUREG-1427, Draft Supplement 15, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants," dated July 2003.

THIS PAGE IS INTENTIONALLY LEFT BLANK

APPENDIX A: COMMITMENTS FOR LICENSE RENEWAL

During the review of the VCSNS LRA by the NRC staff, the applicant made commitments related to aging management programs (AMPs) to manage aging effects of structures and components (Scs) prior to the period of extended operation. The following table lists these commitments, along with the implementation schedule and the source of the commitment.

THIS PAGE IS INTENTIONALLY LEFT BLANK

Appendix A - VCSNS Commitment List Associated with Renewal of the Operating License				
No.	**Commitment**	**FSAR Supp. Location (LRA App. A)**	**Implementation Schedule**	**Source**
1	The applicability of the VCSNS QA Program applies equally to existing programs as to new programs being developed for license renewal. Generic statements regarding the applicability of the VCSNS QA Program will be made to the FSAR Section 18.1 for all of the programs credited to manage aging effects for in-scope SSCs.	18.1, Introduction. New text to be added per RAI response.	Prior to the end of the current operating license term.	Response to RAI 2.1-3
2	The Above Ground Tank Inspection will be consistent with XI.M32, *One-Time Inspection*, as identified in NUREG-1801. The Above Ground Tank Inspection will be performed prior to the period of extended operation.	18.2.3, Above Ground Tank Inspection	Prior to the end of the current operating license term.	LRA Appendix B, Section B.2.1
3	The following enhancements will be incorporated into the Alloy 600 Aging Management Program. Changes indicated by emerging regulatory requirements and developed by the industry groups will be implemented for the applicable Attributes.	18.2.4, Alloy 600 Aging Management Program	Prior to the end of the current operating license term.	LRA Appendix B, Section B.1.1
4	For those systems outside of containment, VCS intends to enhance the Surveillance Test Procedures already required by Technical Specifications for leakage of primary coolant sources outside containment. These leakage assessment tests are for the following systems: Boron Recycle, Liquid Waste, Nuclear Sampling, Chemical and Volume Control, Residual Heat Removal, and RB Spray. In addition to these, VCS intends to enhance the leak tests performed for the SI Accumulators and the Spent Fuel Pool Cooling. These test procedures will be enhanced to specify inspecting for boric acid crystallization on the system being tested and, when boric acid is found, on surrounding systems. The enhancements to the procedures will be noted on the procedures and maintained as license renewal commitments.	18.2.7, Boric Acid Corrosion Surveillances	Prior to the end of the current operating license term.	Response to RAI B.1.2-1
5	The Buried Piping and Tanks Inspection will be consistent with XI.M34, *Buried Piping and Tanks Inspection*, as identified in NUREG-1801.	18.2.9, Buried Piping and Tanks Inspection	Prior to the end of the current operating license term.	LRA Appendix B, Section B.2.10
6	Prior to the period of extended operation, one-time inspections will be conducted In low flow areas of various treated water systems to demonstrate the effectiveness of the Chemistry Program for various material/environment combinations.	18.2.10, Chemistry Program	Prior to the end of the current operating license term.	Response to RAI B.1.4-2; 3.3.2.4.4-1; 3.3.2.4.6-3; 3.3.2.4.6-4; 3.3.2.4.14-1; 3.3.2.4.14-2; 3.4-4
7	The Diesel Generator Systems Inspection will be consistent with XI.M32, *One-Time Inspection*, as identified in NUREG-1801 prior to the period of extended operation. The Diesel Generator Systems Inspection will be performed prior to the period of extended operation.	18.2.13, Diesel Generator Systems Inspection	Prior to the end of the current operating license term.	LRA Appendix B, Section B.2.2

Appendix A - VCSNS Commitment List Associated with Renewal of the Operating License				
No.	**Commitment**	**FSAR Supp. Location (LRA App. A)**	**Implementation Schedule**	**Source**
8	The following enhancement will be incorporated into the Fire Protection Program prior to the period of extended operations. Sprinklers will either be replaced or representative samples will be submitted to a recognized laboratory for field service testing in accordance with NFPA code 25. Subsequent replacement or field service testing of representative samples will occur at 10-year intervals.	18.2.15.1, Mechanical	Prior to the end of the current operating license term.	LRA Appendix B, Section B.1.5; Response to RAI B.1.5-1 of extended operations. Sprink
9	The following enhancement will be incorporated into the Fire Protection Program prior to the period of extended operations. Ultrasonic testing of representative portions of above ground fire protection piping that are exposed to water but do not normally experience flow will be performed before the end of the current operating term. Ultrasonic testing of a representative sample of these stagnant sections of piping will be conducted at 10-year intervals thereafter.	18.2.15.1, Mechanical	Prior to the end of the current operating license term.	LRA Appendix B, Section B.1.5; Response to RAI B.1.5-1
10	A one-time inspection of the Fire Service System will be performed to determine if aging management is required for brass and cast iron components during the period of extended operation. The inspection activity will detect and characterize loss of material due to selective leaching. This inspection will use suitable hardness measurement techniques at the most susceptible (sample) locations.	18.2.15.1, Mechanical	Prior to the end of the current operating license term.	LRA Appendix B, Section B.1.5
11	The Non-EQ Insulated Cables and Connections Inspection Program will be consistent with XI.E1, *Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements*, as identified in NUREG-1801 prior to the period of extended operation.In addition to the visual inspection of in-scope, passive fuse holders on a 10-year periodicity for indication of age related degradation, the metallic fuse clip portion of the in-scope, passive fuse holders that are found to be susceptible to age related degradation, will receive a continuity check or will undergo thermography or other appropriate test on a representative sample basis to assure the metallic fuse clip is still making a good connection.	18.2.18, Non-EQ Insulated Cables and Connections Inspection Program	Prior to the end of the current operating license term.	LRA Appendix B, Section B.2.9
12	The Aging Management Programs for cracking of the Core Support Pads and Bottom Head Penetrations include the Alloy 600 Aging Management Program, Chemistry Program, as well as the In-Service (ISI) Plan. ISI inspections are done in accordance with the ASME code requirements. VCSNS is active in industry groups specifically EPRI and WOG. New developments will be reviewed and if deemed appropriate incorporated into the aging management of the Core Support Pads and Bottom Head Penetrations.	18.2.19, In-Service Inspection (ISI) Plan	Prior to the end of the current operating license term.	Response to RAI 3.1.2.2.9-2

Appendix A - VCSNS Commitment List Associated with Renewal of the Operating License				
No.	**Commitment**	**FSAR Supp. Location (LRA App. A)**	**Implementation Schedule**	**Source**
13	Inspections for Mechanical Components will manage the relevant aging effects for mechanical components constructed of carbon steel, low alloy steel, and other susceptible materials. These inspections will follow the same frequency as Maintenace Rule Inspections (five years) and the baseline inspection would occur within five years of obtaining the new license. Based upon the results of these inspections, or any new industry experience, the frequency may increase.	18.2.20 Inspections for Mechanical Components	Every five years with baseline inspection within five years of obtaining the new license	LRA Appendix B Section B.2.11, Response to RAI B.2.11-4
14	The Liquid Waste System Inspection will be consistent with XI.M32, *One-Time Inspection*, as identified in NUREG-1801 prior to the period of extended operation. The Liquid Waste System Inspection will be performed prior to the period of extended operation.	18.2.21, Liquid Waste System Inspection	Prior to the end of the current operating license term.	LRA Appendix B, Section B.2.3
15	The following enhancements will be incorporated into the Maintenance Rule Structures Program prior to the period of extended operation. (1) - Future inspections will add: North Berm, Electrical Manhole EMH-2 interior inspection, Inaccessible Areas when exposed by excavation, Flood Barrier Seals for Control, Intermediate, and Diesel Generator Buildings, Portions of the power path from the power circuit breaker (PCB) in the substation to the safety related buses, and Groundwater chemical analyses. (2) - Groundwater chemical analyses will include: pH, Sulfates and Chlorides. Groundwater chemical analyses will be used to monitor changes in aggressiveness of the below grade environment.	18.2.22, Maintenance Rule Structures Program	Prior to the end of the current operating license term.	LRA Appendix B, Section B.1.18; Response to RAI 3.5-22
16	The Reactor Building Cooling Unit Inspection will be consistent with XI.M32, *One-Time Inspection*, as identified in NUREG-1801 prior to the period of extended operation. The Reactor Building Cooling Unit Inspection will be performed prior to the period of extended operation.	18.2.26, Reactor Building Cooling Unit Inspection	Prior to the end of the current operating license term.	LRA Appendix B, Section B.2.5

Appendix A - VCSNS Commitment List Associated with Renewal of the Operating License				
No.	**Commitment**	**FSAR Supp. Location (LRA App. A)**	**Implementation Schedule**	**Source**
17	The Reactor Vessel Internals Inspection will be consistent with XI.M16, *PWR Vessel Internals,* as identified in NUREG-1801. The program details have not been developed. VCSNS will follow industry initiatives and will have the program in place prior to the period of extended operation. With respect to cracking due to SCC & IASCC, staff approved recommendations of the industry initiatives applicable to inspection of vessel internals will be implemented. It is the intent of VCSNS to follow staff approved industry initiatives for these inspections. With respect to IASCC, and loss of fracture toughness due to neutron irradiaation embrittement of the RV interval components, VCSNS will follow industry initiatives develop a reactor vessel internals inspection program which will be in place prior to the period of extended operation. It is the intent of VCSNS to follow industry initiatives for this inspections.	18.2.28, Reactor Vessel Internals Inspection	Prior to the end of the current operating license term.	LRA Appendix B, Section B.2.4; Response to RAI B.2.4-2, B.2.4-4, 3.1.2.2.12-1
18	With respect to changes in dimensions due to void swelling, industry activities (including WOG and EPRI) are under way to better characterize the effect and, if necessary, to develop and qualify methods for detection and management. These activities will be monitored by VCSNS and implemented, as applicable. It is the intent of VCSNS to follow industry initiatives for these inspections.	18.2.28, Reactor Vessel Internals Inspection	Prior to the end of the current operating license term.	LRA Appendix B, Section B.2.4; Response to RAIs 3.1.2.2.4-1, 3.1.2.4.4-1, 3.1.2.4.4-2, B.2.4-2, and B.2.4-4
19	The following enhancement will be incorporated into the Reactor Vessel Surveillance Program prior to the period of extended operation. Perform a one-time analysis to demonstrate that the materials in the inlet and outlet nozzles and upper shell course will not become controlling during the period of extended operations.	18.2.29, Reactor Vessel Surveillance Program	Prior to the end of the current operating license term.	LRA Appendix B, Section B.1.24
20	A program will be established at the end of RF-14 to ensure that the plant is operated under conditions to which the surveillance capsules were exposed and the exposure conditions of the Reactor Vessel will be monitored to ensure that they continue to be consistent with those used to project the effects of embrittlement to the end of license. This program may be supplemented or revised by using alternative dosimetry or other effective neutron fluence monitoring techniques during the period of extended operation.	18.2.29, Reactor Vessel Surveillance Program	RF-14	Response to RAI B.1.24-1

Appendix A - VCSNS Commitment List Associated with Renewal of the Operating License				
No.	**Commitment**	**FSAR Supp. Location (LRA App. A)**	**Implementation Schedule**	**Source**
21	The Service Air System Inspection will be consistent with XI.M32, *One-Time Inspection*, as identified in NUREG-1801. The Service Air System Inspection will be performed prior to the period of extended operation.	18.2.30, Service Air System Inspection	Prior to the end of the current operating license term.	LRA Appendix B, Section B.2.6
22	The following enhancements will be incorporated into the Service Water Pond Dam Inspection Program. (1) - Scope - North Dam piezometers will be added. (2) - Parameters Monitored / Inspected - Water level. (3) - Monitoring and Trending - Inspections will be made every 5-years concurrent with the RG 1.127 inspections. (4) - Acceptance Criteria - Nominal elevation of adjacent Service Water Pond and Monticello Reservoir.	18.2.31, Service Water Pond Dam Inspection Program	Prior to the end of the current operating license term.	LRA Appendix B, Section B.1.21
23	The Small Bore Class 1 Piping Inspection will be consistent with XI.M32, *One-Time Inspection*, as identified in NUREG-1801. The Small Bore Class 1 Piping Inspection will be scheduled at or near the end of the second period of the fourth ISI interval. VCSNS will evaluate the small-bore class 1 piping with a methodology that is approved by the Staff. The present approved methodology is to perform destructive examinations of small-bore piping. The approved method will be incorporated into the Small Bore Class 1 Piping Inspection.	18.2.34, Small Bore Class 1 Piping Inspection	Before the end of the second period of the fourth ISI interval.	LRA Appendix B, Section B.2.7; Response to RAI B.2.1-1
24	The Waste Gas System Inspection will be consistent with XI.M32, *One-Time Inspection,* as identified in NUREG-1801. The Waste Gas System Inspection will be performed prior to the period of extended operation.	18.2.39, Waste Gas System Inspection	Prior to the end of the current operating license term.	LRA Appendix B, Section B.2.8
25	The Heat Exchanger Inspections will be consistent with XI.M32, *One-Time Inspection*, and XI.M33, Selective Leaching of Materials, as identified in NUREG-1801. The Heat Exchanger Inspections will be performed prior to the period of extended operation.	18.2.40, Heat Exchanger Inspections	Prior to the end of the current operating license term.	LRA Appendix B, Section B.2.12
26	The Area Based Inspections for Refined 10 CFR 54.4(a)(2) Criteria Commodities is a new one-time inspection that will detect and characterize loss of material due to general, crevice, and pitting corrosion resulting from exposure to an unmonitored and uncontrolled water environment. The Area Based Inspections for Refined 10 CFR 54.4(a)(2) Criteria commodities will be performed prior to the period of extended operation.	18.2.42.	Prior to the end of the current operating license term.	App. B Sec. B.2.13 (Supplement to LRA)
27	This is a new program. A summary description of the X1.E2 GALL type program was provided. In this program, calibration results on fidings of surveillance testing programs will be used to identify the potential exixtence of aging degradation. This program applies to the in-scope instrumentation cables that are included in the circuit during loop calibrations.	18.2.43.	Prior to the end of the current operating license term.	Response to RAI 3.6-2

Appendix A - VCSNS Commitment List Associated with Renewal of the Operating License				
No.	**Commitment**	**FSAR Supp. Location (LRA App. A)**	**Implementation Schedule**	**Source**
28	VCSNS will establish a GALL type program for relevant, non-EQ, in-scope I&C cables with sensitive, low-level signals for the NI and RM systems. Implementation of an alternate program will be considered, when appropriate, for low signal level NI and RM circuit cables without loop calibrations, after the industry finalizes the approach.	18.2.44.	Prior to the end of the current operating license term.	Response to RAI 3.6-2
29	VCSNS recognizes the potential uncertainties involved with water treeing, even with ducts that are sloped to preclude moisture accumulation, and will create a program consistent with NUREG-1801 section XI.E3. The VCSNS program described herein will result in a 10-year test interval by an appropriate industry approved testing method selected to validate the satisfactory condition of the cable insulation and to give some assurance of the remaining life of the cable, while not damaging the cable itself. The specific type of test performed will be determined prior to the initial test. The 10-year interval will commence prior to the start of the period of extended operation.	18.2.45.	Prior to the end of the current operating license term.	Response to RAI 3.6-3
30	Additional analyses are required to calculate Charpy Upper-Shelf Energy for the end of the period of extended operation. Following adequate capsule exposure, a capsule will be withdrawn and analyzed. The Charpy Upper-Shelf Energy will be recalculated for additional fast neutron fluence corresponding to the end of the extended operating period. The capsule will be tested and will provide bounding data for the EOL fluence of 54 EFPY.	18.3.1.1, Upper-Shelf Energy	Prior to the end of the current operating license term.	LRA Section 4.2.1; Response to RAI 4.2.2.1-1
31	The pressure-temperature limit curves will be recalculated following the removal of one of the remaining surveillance capsules from the vessel. The surveillance capsule will be removed when the calculated fast neutron fluence on the capsule meets or exceeds the calculated fast neutron fluence on the vessel wall at the end of the period of extended operation. The Technical Specifications will be updated as required by 10 CFR 50.61. The LTOP analysis will be done as part of this calculation revision.	18.3.1.3, Pressure-Temperature (P-T) Limits	Prior to the end of the current operating license term.	LRA Section 4.2.3; Response to RAI 4.2.2.3-1

Appendix A - VCSNS Commitment List Associated with Renewal of the Operating License				
No.	**Commitment**	**FSAR Supp. Location (LRA App. A)**	**Implementation Schedule**	**Source**
32	The VCSNS Thermal Fatigue Management Program will be revised by the end of the current license term (40 years) to base future projections on 60 years of operation and to account for environmental effects of the reactor coolant environment on RCS components. For the NUREG/CR-6260 locations, VCSNS will evaluate the Fatigue Environmental Effects prior to the period of extended operation. VCSNS will evaluate the fatigue usage for components with a methodology that Is approved by the Staff. The present approved methodology Is to use the correlations contained In NUREG/CR-6583, for Carbon and Low-Alloy Steels and NUREGICR-5704, for Austenitic Stainless Steels. Component CUF will be maintained below 1.0.	18.3.2.1, ASME Section III, Class 1	Prior to the end of the current operating license term.	LRA Section 4.3.1; Response to RAI 4.3.1-4 and 4.3.1-5
33	The leak-before-break analyses are currently valid for 40 years. The analyses require revision in order to demonstrate that the design is adequate for the extended period of operation.	18.3.2.2, Leak-Before-Break Analyses	Prior to the end of the current operating license term.	LRA Section 4.7.2
34	[RC Loop 'B' hot leg sampling portion of SS.] The present sampling method seldom uses loop sampling. VCSNS will administratively limit of activities on the "B" RCS loop sampling line in order to account for 60 years of plant operation.	18.3.2.3, ASME Section III, Class 2 and 3 Piping Fatigue	Prior to the end of the current operating license term.	LRA Section 4.3.2; Response to RAI 4.3.2-1
35	Prior to the period of extended operation, the equipment subject to the provisions of 10 CFR 50.49 will be re-evaluated for 60 years of installation. Components not meeting a 60 year qualified life will be replaced prior to expiration of qualified life.	18.3.3, Environmental Qualification (EQ)	Prior to the end of the current operating license term.	LRA Appendix B, Section B.3.1
36	As appropriate, station documents will be revised or established, implemented, and maintained to cover the aging management programs and activities described in Chapter 18.	Appendix A Prefix, FSAR Supplement	Varies by program and activity	LRA Appendix A, page 1. Various RAI responses
37	At VCSNS, the Boraflex neutron absorbing sheets will be replaced with Boral neutron absorbing sheets prior to the Refueling Outage 14 (September 2003).	N/A - Aging management is not required for the new components.	RF-14, September 2003	LRA Table 3.3-1, AMR items 9, 12

Appendix A - VCSNS Commitment List Associated with Renewal of the Operating License				
No.	Commitment	FSAR Supp. Location (LRA App. A)	Implementation Schedule	Source
38	VCSNS is developing a process which will be implemented to capture the LRA methodology and guidance for use during the period of extended operation to satisfy the requirements of 10 CFR 54.35. Existing plant programs and procedures (associated with aging management) will be revised and/or enhanced to identify those commitments (governed by the license / CLB) which cannot be altered without prior review against the LRA criteria. New ""one-time inspection"" aging management programs will be developed in accordance with the LRA, incorporating the commitment process identified above.	N/A - Implementation activity.	Prior to the end of the current operating license term.	Response to RAI 2.1-2
39	Plant procedures which impact "control of facility changes", including modifications and documentation, will be reviewed to determine an acceptable screening review process against the 10 CFR 54 requirements to ensure consistency with the LRA methodology and guidance.	N/A	Prior to the end of the current operating license term.	Response to RAI 2.1-2
40	To support Items 50 and 51 above, a License Renewal DBD will be developed as a guidance document which can be used for all future plant procedure, documentation and modification changes to ensure consistency with 10 CFR 54.	N/A	Prior to the end of the current operating license term.	Response to RAI 2.1-2
41	All Technical Reports, which have been developed to substantiate the LRA submittal, are filed as permanent records and will be available for future reference and/or update.	N/A	Prior to the end of the current operating license term.	Response to RAI 2.1-2

APPENDIX B: CHRONOLOGY

This appendix provides a chronological listing of routine licensing correspondence between the U.S. Nuclear Regulatory Commission (NRC) staff and South Carolina Electric & Gas Company (SCE&G) and other correspondence regarding the NRC staff's review of the Virgil C. Summer Nuclear Station (VCSNS), for license renewal application (LRA) (Docket Nos. 50-395).

August 6, 2002	In a letter (signed by S.A. Byrne), SCE&G submitted its LRA for Virgil C. Summer Nuclear Station to the NRC.
August 20, 2002	In a letter (signed by G.A. Suber), NRC confirmed a telephone conversation concerning the maintenance of reference material for the Virgil C. Summer Nuclear Station LRA.
August 26, 2002	In a letter (signed by P. Kuo), NRC informed SCE&G that the NRC received the Virgil C. Summer Nuclear Station license renewal application on August 6, 2002, and enclosed a copy of the notice related to the application that was sent to the Office of Federal Register for publication.
August 27, 2002	NRC announced the availability of License Renewal Application for the Virgil C. Summer Nuclear Station.
September 12, 2002	In a letter, R. Auluck noticed a meeting to provide the NRC staff an overview of the Virgil C. Summer Nuclear Station LRA, on September 24, 2003.
September 12, 2002	In a letter SCE&G provided the NRC additional information on Section 2 of the Virgil C. Summer Nuclear Station, LRA.
September 27,2002	In a letter (signed by P. Kuo), the NRC informed the SCE&G that tha NRC staff had determinated that SCE&G had submitted sufficient information that was complete and acceptable for docketing, proposed review schedule, and opportunity for hearing.
October 23,2002	In a letter (signed by P. Kuo), the NRC informed of its intent to prepare an Environmental Impact Statement and conduct the scoping process for the LRA of VCSNS.
October 24, 2002	In a meeting summary (signed by R. Auluck), NRC summarized the September 24, 2002, meeting with SCE&G regarding the VCSNS license renewal application.
November 27, 2002	NRC announced to hold a public meeting on December 11, 2002, on Summer Nuclear Station License Renewal.

December 10, 2002	In a letter, R. Auluck announced a forthcoming meeting to discuss the environmental scoping process for VCSNS License Renewal Application, on December 11, 2003.
December 11, 2002	In a letter (signed by G. Sober), the NRC provided the handouts for the meeting, which discuss the environmental scoping process for the Virgil C. Summer Nuclear Station LRA.
December 12, 2002	In a letter (signed by R. Caruso), NRC requested additional information (RAI) on Section 15.4.3.2.2 of the Virgil C. Summer Nuclear Station LRA.
December 12, 2002	In a letter, R. Auluck announced a forthcoming meeting to discuss staff's review/draft questions on Section 3.5 of the VCSNS License Renewal Application, on January 8, 2003.
December 23, 2002	In a letter (signed by R. Auluck), NRC provided the revision of the schedule for the conduct of review of the VCSNS License Renewal Application.
January 9, 2003	In a letter (signed by S. Byrne), SCE&G provided its response to the NRC RAIs on VCSNS License Renewal.
January 14, 2003	In a meeting summary (signed by G. Suber), NRC summarized the December 11, 2002 public meeting with SCE&G, to support review of VCSNS License Renewal Application.
January 15, 2003	In a letter, R. Auluck announced a forthcoming meeting to summarize the review of the VCSNS on-site information related to the scoping and screening methodology used in developing the VCSNS License Renewal Application, on January 31, 2003.
February 14, 2003	In a letter (signed by D. Thatcher), NRC requested additional information (RAI) regarding the SCE&G license renewal of the Virgil C. Summer Nuclear Station.
February 14, 2003	In a letter, R. Auluck announced a forthcoming meeting to discuss staff's draft questions on Sections 2.0, 3.1, 3.2, 3.4, and 4.0 of the VCSNS License Renewal Application and related aging management programs in Appendix B of the application, on February 26, 2003.
February 21, 2003	In a letter, R. Auluck announced a forthcoming meeting to discuss staff's draft questions on Sections 3.3, 3.4, and Appendix B of the VCSNS License Renewal Application, on March 5-6, 2003.

February 27, 2003	In a letter (signed by C.F. Holden), NRC requested additional information (RAI) on Section 3.6 of the Virgil C. Summer Nuclear Station LRA.
February 28, 2003	In a meeting summary (signed by R. Subbaratnam), NRC summarized the January 8, 2003, meeting with SCE&G, to discuss staff questions on Section 3.5 and 4.5 of the VCSNS License Renewal Application.
March 3, 2003	In a letter (signed by K.A. Manoly), NRC requested additional information (RAI) on Section 2.4 “Scoping and Screening Results-Structures” of the Virgil C. Summer Nuclear Station LRA.
March 4, 2003	NRC presented the Virgil C. Summer Nuclear Station Inspection Plan for March1, 2003, to March 31, 2004, for the license renewal
March 4, 2003	In a letter (signed by S.A. Weerakkody), NRC requested additional information (RAI) on Section 2.2, 2.3, 3.3.2, and Appendix B.1.5 of the Virgil C. Summer Nuclear Station LRA.
March 5, 2003	In a letter (signed by A. Louise Lund), NRC requested additional information (RAI) on materials related aging management programs of the Virgil C. Summer Nuclear Station LRA.
March 5, 2003	In a letter (signed by S. Coffin), NRC requested additional information (RAI) on the aging management of reactor vessel, internals and reactor coolant system of the Virgil C. Summer Nuclear Station LRA.
March 6, 2003	In a letter (signed by K.A. Manoly), NRC requested additional information (RAI) on Sections B1.9, B1.19, B1.25, B1.26, B 2.2, B2.3, B2.5, B2.6, B2.8, B2.11, and B2.12 of the Virgil C. Summer Nuclear Station LRA.
March 10, 2003	In a letter (signed by K.A. Manoly), NRC requested additional information (RAI) on Section 3.5 of the Virgil C. Summer Nuclear Station LRA.
March 11, 2003	In a letter (signed by K.A. Manoly), NRC requested additional information (RAI) on Steam and Power Conversion System of the Virgil C. Summer Nuclear Station LRA.
March 12, 2003	In a letter (signed by K.A. Manoly), NRC requested additional information (RAI) on Engineered Safety Features System of the Virgil C. Summer Nuclear Station LRA.

March 17, 2003	In a letter (signed by K.A. Manoly), NRC requested additional information (RAI) regarding the time limited aging analyses for the Virgil C. Summer Nuclear Station LRA.
March 18, 2003	In a letter (signed by K.A. Manoly), NRC requested additional information (RAI) on auxiliary system for the Virgil C. Summer Nuclear Station LRA.
March 19, 2003	In a letter (signed by S. Byrne), SCE&G provided its response to the NRC RAIs regarding Severe Accident Mitigation Alternatives (SAMA) for the Virgil C. Summer Nuclear Station.
March 28, 2003	In a letter (signed by R. Auluck), NRC requested additional information (RAI) on Section 3.2, 3.3, 3.4, 3.5, and 4.0 and related Appendix B sections of the Virgil C. Summer Nuclear Station LRA.
March 28, 2003	In a letter (signed by R. Auluck), NRC requested additional information (RAI) on Section 3.1, and related Appendix B sections of the Virgil C. Summer Nuclear Station LRA.
March 28, 2003	In a letter (signed by R. Auluck), NRC requested additional information (RAI) on Section 2.4, 2.5, 3.6, and 4.0 and related Appendix B sections of the Virgil C. Summer Nuclear Station LRA.
March 28, 2003	In a letter (signed by R. Auluck), NRC requested additional information (RAI) on Section 2.1, 2.2, 2.3, and 3.3 and related Appendix B sections of the Virgil C. Summer Nuclear Station LRA.
April 2, 2003	In a letter (signed by M. Browne), NRC requested SCE&G to provide to NRC a copy of the modification to the Virgil C. Summer Nuclear Station National Pollution Discharge Elimination System (NPDES).
April 9, 2003	In a letter (signed by R. Auluck), NRC requested additional information (RAI) on Section 2.3 of the Virgil C. Summer Nuclear Station LRA.
April 15, 2003	In a letter (signed by K. Cotton), NRC requested additional information (RAI) regarding Engineered Safety Features Actuation System Technical Specifications for the Virgil C. Summer Nuclear Station.
April 25, 2003	In a letter (signed by C. Carpenter, V. McCree), NRC requested SCE&G to provide the Virgil C. Summer Nuclear Station License Renewal Plan.

May 2, 2003	In a letter, P. E. Fredrickson announced a forthcoming meeting to present the results of the NRC's first inspection of the VCSNS License Renewal Program, on May 16, 2003.
May 9, 2003	In a meeting summary (signed by R. Subbaratnam), NRC summarized the February 26-27, 2003 and March 5, 2003, meetings with SCE&G, to discuss the staff's draft request for additional information on sections 2.0, 3.1, 3.2, 3.3, 3.4, 4.0 and Appendix B of the VCSNS License Renewal Application.
May 19, 2003	In a meeting summary (signed by G. F. Suber), NRC summarized the May 5, 2003, teleconference with SCE&G, to discuss and clarify certain responses to the RAIs submitted to the NRC by letter dated March 19, 2003.
May 21, 2003	In a letter (signed by S. Byrne), SCE&G provided its response to the NRC RAIs regarding Severe Accident Mitigation Alternatives (SAMAs) for the Virgil C. Summer Nuclear Station.
May 22, 2003	In a letter (signed by P. Kuo), NRC provided to SCE&G the aging management program audit plan for Virgil C. Summer Nuclear Station License Renewal.
June 2, 2003	In a letter (signed by R. Auluck), NRC requested additional information (RAI) as a result of a scoping inspection conducted at the Virgil C. Summer Nuclear Station during May 12-16, 2003.
June 12, 2003	In a letter (signed by S. Byrne), SCE&G provided its response to the NRC RAIs for the review of the license renewal application of the Virgil C. Summer Nuclear Station.
June 13, 2003	In a letter (signed by P. Kuo), NRC provided to SCE&G the Virgil C. Summer Nuclear Station License Renewal review and the National Prevention Act.
June 13, 2003	In a letter (signed by V. McCree), NRC provided to SCE&G its scoping inspection report.
July 17, 2003	In a letter (signed by V. McCree), NRC announced a forthcoming meeting to present the results of the second inspection of the VCSNS License Renewal program on August 4-22, 2003.
July 31, 2003	NRC published a draft report for comments, "Generic Environmental Impacts for License Renewal of Nuclear Plants" regarding VCSNS.

July 31, 2003	In a letter (signed by S. Byrne), SCE&G provided to the NRC the updated application for renewed operating license of the Virgil C. Summer Nuclear Station.
August 11, 2003	In a telecommunication summary (signed by R. Subbaratnam), NRC summarized the June 17, 2003, to July 31, 2003, telephone conversations with SCE&G, to discuss related additional clarification that the staff needed to complete its safety review of the VCSNS License Renewal Application.
August 15, 2003	In a letter (signed by G. Suber), NRC announced a forthcoming meeting on August 26, 2003, to discuss the draft supplemental environmental impact statement for the VCSNS.
August 18, 2003	In a telecommunication summary (signed by R. Auluck), NRC summarized the May 27, June 26 and August 7, 2003, telephone conversations with SCE&G, to discuss applicant's response to various staff requests for additional information for the VCSNS License Renewal Application Review.
September 2, 2003	In a letter (signed by S. Byrne), SCE&G provided its response to the NRC RAIs for the review of the license renewal application of the Virgil C. Summer Nuclear Station.
September 24, 2003	In a letter (signed by S. Byrne), SCE&G provided its response to the NRC RAIs for the review of the license renewal application of the Virgil C. Summer Nuclear Station.
September 29, 2003	In a letter (signed by V. McCree), NRC provided to SCE&G its aging management review inspection report.
October 3, 2003	In a telecommunication summary (signed by R. Subbarantnam), NRC summarized the September 2, 15, 16, 17, and 19, 2003, telephone conversations with SCE&G, to discuss staff questions on 10 CFR 54.4(a)(2) criteria and applicant's responses to the NRC RAIs for the review of the license renewal application of the Virgil C. Summer Nuclear Station.
October 9, 2003	In a letter (signed by R. Auluck), NRC provided to SCE&G its aging management program audit report.

APPENDIX C: REFERENCES

This appendix contains a listing of references used in the preparation of the Safety Evaluation Report prepared during the review of the license renewal application for VCSNS, Docket Number 50-395.

American Society of Mechanical Engineers (ASME)

ASME Boiler and Pressure Vessel Code, Section III, Subsection NB, *Class 1 Components*.

ASME Boiler and Pressure Vessel Code, Section III, Subsection NG, *Core Support Structures*.

ASME Boiler and Pressure Vessel Code, Section III, *Class 2 and 3 Piping Failures*.

ASME Boiler and Pressure Vessel Code, Section III, Subsection ND, *Class 3 Rules for Construction of Nuclear Power Plant Components*.

ASME Boiler and Pressure Vessel Code, Section XI, *Rules for Inservice Inspection of Nuclear Power Plant Components,* 1992 Edition.

ASME Boiler and Pressure Vessel Code, Section XI, *Rules for Inservice Inspection of Nuclear Power Plant Components*, 1989 Edition.

ASME Boiler and Pressure Vessel Code, Section XI, Subsection IWB, *Requirements for Class 1 Components of Light-Water Cooled Power Plants*.

ASME Boiler and Pressure Vessel Code, Section XI, Subsection IWC, *Requirements for Class 2 Components of Light-Water Cooled Power Plants*.

ASME Boiler and Pressure Vessel Code, Section XI, Subsection IWE, *Requirements for Class MC and Metallic Liners of Class CC Components of Light-Water Cooled Power Plants.*

ASME Boiler and Pressure Vessel Code, Section XI, Subsection IWF, *Requirements for Class 1, 2, 3, and MC Component Supports of Light Water Cooled Plants*.

ASME Boiler and Pressure Vessel Code, Section XI, Appendix G, *Fracture Toughness Criteria for Protection Against Failure*.

ASME Boiler and Pressure Vessel Code, Code Case N-481, *Alternative Examination Requirements for Cast Austenitic Pump Casings, Section XI, Division 1*.

ANSI B30.16, *Overhead Hoists (Underhung)*, American National Standard.

ANSI B30.2.0, *Overhead and Gantry Cranes, Section 2-2, Safety Standards for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings*, American National Standard.

Department of Energy - National Laboratories

Sandia Contractor Report SAND96-0344, *Aging Management Guideline for Commercial Nuclear Power Plants - Electrical Cable and Terminations*, Prepared by Ogden Environmental and Energy Services, Inc., printed September 1996.
SAND 93-7069, *Aging Management Guideline for Commercial Nuclear Power Plants - Motor Control Centers*, February 1994.

SAND 93-7027, *Aging Management Guideline for Commercial Nuclear Power Plant - Electrical Switchgear*.

Electric Power Research Institute (EPRI) and Materials Reliability Program (MRP)

EPRI Report TR-105714, Volumes 1, Revision 4, and Volume 2, Revision 4 *PWR Primary Water Chemistry Guidelines*, January 1999.

EPRI Report TR-102134, Revision 5, *PWR Secondary Water Chemistry Guidelines*, December 1999.

EPRI Report TR 107621, Revision 1, *Steam Generator Examination Guidelines*, September 1997.

EPRI Report NSAC-202L, Revision 2, *Recommendations for an Effective Flow Accelerated Corrosion Program*, December 1998.

EPRI Report TR-103834-P1-2, *Effects of Moisture on the Life of Power Plant Cables, Part 1: Medium-Voltage Cables, Part 2: Low-Voltage Cables*, prepared by Ogden Environmental and Energy Services Company, Final Report, August 1994

EPRI Report TR-10003057, *License Renewal Electrical Handbook*, November 2001.

EPRI Report TR-107396, *Closed Cooling Water Chemistry Guidelines*, October 1997.

EPRI Report TR-109619, *Guideline for the Management of Adverse Localized Equipment Environment,* June 1999.

EPRI Report TR-1003083, *Materials Reliability Program Guidelines for Addressing Fatigue Environmental Effects in a License Renewal Application (MRP-47)*, October 2001.

MRP Topical Report TP-1001491, Part 2, *PWR Materials Reliability Program Interim Alloy 600 Safety Assessment for US Power Plants (MRP-44)*, May 2001.

Miscellaneous

Aging and Life Extension of Major Light Water Reactor Components, edited by V.N. Shah and P.E. MacDonald, 1993, Elsevier Science Publishers.

American Concrete Institute, ACI 349.3, *Evaluation of Existing Nuclear Safety-Related Concrete Structures.*

American Concrete Institute, ACI 224.1, *Causes, Evaluation, and Repairs of Cracks in Concrete Structures.*

American Concrete Institute, ACI 201, *Guide for Making a Condition Survey of Concrete in Service.*

NRC Inspection Procedure 62002, *Inspection of Structure, Passive Components, and Civil Engineering Features at Power Plants*, December 1996.

NRC SECY 96-080, *Issuance of Final Amendment to 10 CFR 50.55a to incorporate by reference the ASME Boiler and Pressure Vessel Code (ASME CODE), Section XI, Division 1, Subsection IWE and Subsection IWL,* April 17, 1996.

Nuclear Energy Institute (NEI)

NEI 95-10, Revision 2, *Industry Guideline for Implementing the Requirements of 10 CFR Part 54 - The License Renewal Rule*, Nuclear Energy Institute, August 2000.

NEI 95-10, Revision 3, *Industry Guideline for Implementing the Requirements of 10 CFR Part 54 - The License Renewal Rule*, Nuclear Energy Institute, March 2001.

NEI 97-06, *Steam Generator Program Guidelines*, 1997.

NEI 96-03, *Industry Guideline for Monitoring Structures*.

Nuclear Management and Resources Council (NUMARC)

Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors, NUMARC Report Number 87-00, November 1987.
Pressurized Water Reactor Containment Structures License Renewal Industry Report, NUMARC Report Number 90-01, Nuclear Management and Resources Council, Revision 1, September 1991.

Class I Structures License Renewal Industry Report, NUMARC Report Number 90-06, Nuclear Management and Resources Council, Revision 1, December 1991.

US Nuclear Regulatory Commission (NRC)

Bulletins (BL)

BL 88-09, *Thimble Tube Thinning in Westinghouse Reactors*, July 26, 1988.

BL 2001-001, *Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles*, August 3, 2001.

BL 2002-01, *Reactor Pressure Vessel Head Degradation and Reactor Coolant Pressure Boundary Integrity*, March 18, 2002.

BL 2002-02, *Reactor Pressure Vessel Head and Vessel Head Penetration Nozzle Inspection Programs*.

BL 82-02, *Degradation of Threaded Fasteners in the Reactor Coolant Pressure Boundary of PWR Plants,* June 2, 1982.

BL 88-11, *Pressurizer Surge Line Thermal Statification*, December 20, 1988.

Code of Federal Regulations (10 CFR)

10 CFR 50.36, *Technical Specifications*, U.S. Nuclear Regulatory Commission.

10 CFR 50.48, *Fire Protection*, U.S. Nuclear Regulatory Commission.

10 CFR 50.49, *Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants*, U.S. Nuclear Regulatory Commission.

10 CFR 50.55a, *Codes and Standards*, U.S. Nuclear Regulatory Commission.

10 CFR 50.61, *Fracture Toughness Requirements for Protection Against Pressurized Thermal Shock Events*, U.S. Nuclear Regulatory Commission.

10 CFR 50.62, *Requirements for Reduction of Risk from Anticipated Transients without Scram (ATWS) Events for Light-water-cooled Nuclear Power Plants*, U.S. Nuclear Regulatory Commission.

10 CFR 50.63, *Loss of All Alternating Current Power*, U.S. Nuclear Regulatory Commission

10 CFR 50.90, *Application for Amendment of License or Construction Permit*, U.S. Nuclear Regulatory Commission.

10 CFR 50 *Domestic Licensing of Production and Utilization Facilities,* U.S. Nuclear Regulatory Commission.

10 CFR Part 50, Appendix G, *Fracture Toughness Requirements*, U.S. Nuclear Regulatory Commission.

10 CFR Part 50, Appendix H, *Reactor Vessel Material Surveillance Program Requirements*, U.S. Nuclear Regulatory Commission.

10 CFR Part 51, *Environmental Protection Regulation for Domestic Licensing and Related Regulatory Functions*, U.S. Nuclear Regulatory Commission.

10 CFR Part 54, *Requirements for Renewal of Operating Licenses for Nuclear Power Plants*, U.S. Nuclear Regulatory Commission.

10 CFR 100, *Reactor Site Criteria*, U.S. Nuclear Regulatory Commission.

10 CFR Part 100, Appendix A, *Seismic and Geological Siting Criteria for Nuclear Power Plants*, U.S. Nuclear Regulatory Commission.

29 CFR Chapter XVII, 1910.179, *Overhead and Gantry Cranes*, Occupational Safety and Health Administration.

Correspondence

Letter from C. I. Grimes (NRC) to D. J. Walters (NEI), License Renewal Issue No. 98-0030, *Thermal Aging Embrittlement of Cast Austenitic Stainless Steel Components*, May 19, 2000.

Letter from W. T. Russell (NRC) to W. Rasin (NUMARC, [NEI]), *Safety Evaluation for Potential Reactor Vessel Head Adaptor Tube Cracking*, November 19, 1993.

Letter from C. I. Grimes (NRC) to D. J. Walters (NEI), License Renewal Issue No. 98-0012, *Consumables*, April 20, 1999.

Inspection Reports

V.C. Summer Nuclear Station - NRC Inspection Report No. 50-395/03-07, June 13, 2003.

V.C. Summer Nuclear Station - NRC Inspection Report No. 50-95

National Fire Codes 1979

National Fire Protection Association (NFPA), *Standard for Installation of Centrifugal Fire Pumps*, June 1978.

National Fire Protection Association (NFPA), *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, 1998.

Generic Letters (GL)

GL 88-05, *Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components In PWR Plants*, March 17, 1988.

GL 97-01, *Degradation of Control Rod Drive Mechanism Nozzle and Other Vessel Closure Head Penetrations*, April 1, 1997.

GL 97-06, *Degradation of Steam Generator Internals*, December 30, 1997.

GL 89-13, *Service Water System Problems Affecting Safety-Related Equipment*, July 18, 1989.

GL 96-04, *Boraflex Degradation in Spent Fuel Pool Storage Racks,* June 26, 1996.

Information Notices (IN)

IN 87-44, *Thimble Tube Thinning in Westinghouse Reactors*, September 16, 1987.

IN 2001-05, *Through-Wall Circumferential Cracking of Reactor Pressure Vessel Head Control Rod Drive Mechanism Penetration Nozzles at Oconee Nuclear Station, Unit 3*, April 30, 2001.

IN 87-49, *Deficiencies in Outside Containment Flooding Protection*, October 9, 1987.

IN 97-45, *Supplement 1:Environmental Qualification Deficiency for Cables and Containment Penetration Pigtails*, February 17, 1998.

Technical Reports

NUREG/CR-1437, Supplement 15, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants Regarding V.C. Summer Nuclear Station,* July 2003.

NUREG/CR-1557, *Summary of Technical Information and Agreements From Nuclear Management and Resources Council Industry Reports Addressing License Renewal,* October 1996.

NUREG-1611, *Aging Management of Nuclear Power Plant Containments for License Renewal*, September 1997.

NUREG/CR-1723, *Safety Evaluation Report Related to the License Renewal of Oconee Nuclear Station, Unit 1, 2 and 3*, March 2000.

NUREG/CR-1739, *Analysis of Public Comment on the Improved License Renewal Guidance Documents*, July 2001.

NUREG-1760, *Aging Assessment of Safety-Related Fuses Used in Low- and Medium-Voltage Applications in Nuclear Power Plants,* May 2002.

NUREG/CR-1800, *Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants*, July 2001.

NUREG/CR-1801, *Generic Aging Lessons Learned (GALL) Report*, July 2001.

NUREG/CR-4652, *Report on Aging of Nuclear Power Plant Reinforced Concrete Structures.*

NUREG/CR-4715, *An Aging Assessment of Relay and Circuit Breakers and System Interactions*, June 1987.

NUREG/CR-5576, *Survey of Boric Acid Corrosion of Carbon Steel Components in Nuclear Plants*, June 1990.

NUREG/CR-5704, *Curves of Austenitic Stainless Steel*, April 1999.

NUREG/CR-6048, *Pressurized-Water Reactor Internals Aging Degradation Study*, September 1993.

NUREG/CR-6177, *Assessment of Thermal Embrittlement of Cast Stainless Steels*, DAATE.

NUREG/CR-6260, *Application of NUREG/CR 5999 Interim Fatigue Curves to Selected Nuclear Power Plant Components*, March 1995.

NUREG/CR-6424, *Report on Aging of Nuclear Power Plant Reinforced Concrete Structures,* .

NUREG/CR-6583, *Effects of LWR Coolant Environment on Fatigue Design Curves of Carbon and Low Alloy Steel*, March 1998.

NUREG/CR-6679, *Assessment of Age-Related Degradation of Structures and Passive Components for U.S. Nuclear Power Plants,* August 2000.

NUREG/CR-6754, *Review of Industry Responses to NRC Generic Letter 97-06 on Degradation of Steam Generator Internals*, December 2001.

Regulatory Guides (RG)

RG 1.43, *Control of Stainless Steel Weld Cladding of Low-Alloy Steel Components*, May 1973.

RG 1.44, *Control of the Use of Sensitized Stainless Steel*, May 1973.

RG 1.45, *Reactor Coolant Pressure Boundary Leakage Detection Systems,* May 1973.

RG 1.52, *Design Testing and Maintenance Criteria for Post Accident Engineered-Safety-Feature Atmosphere Cleanup System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants,* July 1978.

RG 1.89, *Environmental Qualification of Certain Electrical Equipment Important to Safety for Nuclear Power Plant*, June 1984.

RG 1.99, Revision 2, *Radiation Embrittlement of Reactor Pressure Vessel Materials*, May 1988.

RG 1.127, *Inspection of Water Control Structures Associated with Nuclear Power Plants*, March 1978.

RG 1.147, *Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1*, May 1999.

RG 1.155, *Station Blackout*, August 1988.

RG 1.160, *Monitoring the Effectiveness of Maintenance at Nuclear Power Plants,* Revision 2, March 1997.

RG 1.163, *Performance-Based Containment Leak-Test Program*, September 1995.

RG 1.188, *Standard Format and Content for Applications to Renew Nuclear Power Plant Operating Licenses*, July 2001.

RG 1.190, *Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence*, March 2001.

Westinghouse Topical Reports (WCAP)

WCAP-10456, *The Effects of Thermal Aging on Structural Integrity of Cast Stainless Steel Piping for Westinghouse Nuclear Steam Supply Systems, November 1983.*

WCAP-12866, *Bottom Mounted Instrumentation Flux Thimble Wear*, 1991.

WCAP-14535A, *Topical Report on Reactor Coolant Pump Flywheel Inspection Elimination*, November 1996.

WCAP-14574, *License Renewal Evaluation: Aging Management Evaluation for Pressurizers.*

WCAP-14574-A, *License Renewal Application: Aging Management Evaluation for Pressurizers*, December 2000.

WCAP-14575-A, *Aging Management Evaluation for Class 1 Piping and Associated Pressure Boundary Components,* August 1996.

WCAP-14577, Revision 1-A, *License Renewal Application: Aging Management Evaluation for Reactor Internals*, March 2001.

WCAP-14901, Revision 0, *Background and Methodology for Evaluation of Reactor Vessel Closure Head Penetration Integrity for the Westinghouse Owners Group*, July 1997.

APPENDIX D: PRINCIPAL CONTRIBUTORS

NAME	RESPONSIBILITY
R. Auluck	Sr. Project Manager
F. Akstulewicz	Management Supervision
T. Chan	Management Supervision
P. Y. Chen	Technical Support
S. Coffin	Management Supervision
K. Corp	Program Support
K. Coyne	Quality Assurance
Z. Cruz	Technical Support
B. Elliot	Materials Engineering
J. Fair	Mechanical Engineering
G. Georgiev	Materials Engineering
J. Guo	Plant Systems
A. Hodgdon	Legal Counsel
N. Iqbal	Fire Protection
D. Jeng	Mechanical Engineering
R. Jenkins	Management Supervision
S. Jones	Plant Systems
C. Jullian	Region II Inspector
M. Khanna	Materials Engineering
J. Knox	Electrical Engineering
P.T. Kuo	Management Supervision
C. Lauron	Chemical Engineering
A. Lee	Mechanical Engineering
S. Lee	Management Supervision
M. Lemoncelli	Legal Counsel
Y. Li	Mechanical Engineering
L. Lund	Management Supervision
J. Ma	Mechanical Engineering
K. Manoly	Management Supervision
M. Matrzman	Civil Engineering
S. Mirando	Reactor Systems
C. Munson	Civil Engineering
D. Nguyen	Electrical Engineering
Q. Nguyen	Technical Support
K. Parcheski	Chemical Engineering
R. Pettis	Quality Assurance
J. Pulsipher	Plant Systems
J. Rajan	Civil Engineering
J. Raval	Plant Systems
D. Shum	Plant Systems
J. Strnisha	Mechanical Engineering
R. Subbaratnam	Project Manager
D. Terao	Management Supervision
D. Thatcher	Management Supervision

J.Tsao	Materials Engineering
H. Wagage	Plant Systems
S. Weerakkady	Management Supervision
C. Wu	Mechanical Engineering

CONTRACTORS

Contractor	Laboratory
J. Braverman	Brookehaven National Laboratory
D. Diercks	Argonne National Laboratory
C. Hofmayer	Brookehaven National Laboratory
A. Hull	Argonne National Laboratory
Z. Li	Argonne National Laboratory
Y. Liu	Argonne National Laboratory
D. Ma	Argonne National Laboratory
R. Morante	Brookehaven National Laboratory
D. Raske	Argonne National Laboratory
V. Shah	Argonne National Laboratory
S. Tam	Argonne National Laboratory