Summary of Aging Management Program Effectiveness Audits to Inform Subsequent License Renewal: R.E. Ginna Nuclear Power Plant and Nine Mile Point Nuclear Station, Unit 1

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ABSTRACT

Title 10 of the *Code of Federal Regulations*, Part 54 (10 CFR 54), provides rules for renewal of the license of a nuclear power plant (NPP) beyond the initial 40 years for an additional 20 years. However, neither the Atomic Energy Act of 1954 (as amended) nor the subsequent U.S. Nuclear Regulatory Commission (NRC) regulations for renewal include any specific limitations on the number of times a license may be renewed. To ensure its readiness to review possible license renewal applications (LRAs) for NPPs to operate beyond 60 years, the NRC is developing guidance documents for the technical review of applications for subsequent license renewal (SLR), i.e., that would authorize plant operation beyond 60 years. The current guidance documents used for the review of LRAs for operation up to 60 years are the “Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants” (NUREG-1800) and the Generic Aging Lessons Learned (GALL) Report (NUREG-1801). An important part of this guidance document development activity is the identification of the aging effects for systems, structures, and components (SSCs) within the scope of the license renewal rule that would be important to consider for plant operation beyond 60 years, along with development of aging management programs (AMPs) that will be effective in managing the identified aging effects.

As part of its efforts to develop guidance, the NRC is performing “AMP Effectiveness Audits” to provide an understanding of how AMPs have been implemented by NPPs during the period of extended operation (PEO) from 40 to 60 years and the degradation that may have been identified by the AMPs. The results from these audits will provide key information to aid the NRC in identifying needed changes to existing AMPs and new AMPs that may be needed to provide assurance of safe plant operation during an SLR operating period. On a pilot basis, NRC staff, with assistance from Argonne National Laboratory, conducted onsite AMP audits for the Robert Emmett Ginna (Ginna) and Nine Mile Point Unit 1 (NMP-1) NPPs.

This report provides the staff’s observations from the AMP audits at Ginna and NMP-1, but does not make generic conclusions, as only two of the more than 100 operating plants are addressed herein. The results from these audits have been used to refine the approach for additional AMP Effectiveness Audits at other NPPs. The staff believes that the audit enhancements will widen its knowledge base and help enable the staff to draw conclusions toward the development of guidance documents for SLR.

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EXECUTIVE SUMMARY

Title 10 of the *Code of Federal Regulations* (10 CFR) Part 54, provides rules for renewal of the license of a nuclear power plant (NPP) beyond the initial 40 years for an additional 20 years. This regulation does not preclude a licensee from requesting approval for an additional operating period beyond the 20-year period of extended operation (PEO), and states, in §54.31(d), that "a renewed license may be subsequently renewed." The U.S. Nuclear Regulatory Commission (NRC) is aware that some licensees are considering submitting applications for a subsequent 20-year (presumably) operating period beyond 60 years. The first of these applications could possibly be submitted as early as 2017. To ensure readiness for review of possible applications for subsequent license renewal (SLR), the NRC is developing guidance documents for the technical review of such applications for SLR, i.e., that would authorize plant operation beyond 60 years. The current guidance documents used for the review of LRAs for operation up to 60 years are the "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants" (NUREG-1800) and the Generic Aging Lessons Learned (GALL) Report (NUREG-1801). An important part of this guidance document development activity is the identification of aging effects for systems, structures, and components (SSCs) within the scope of the license renewal rule that would be important to consider for plant operation beyond 60 years, along with the development of aging management programs (AMPs) that will be effective in managing the identified aging effects.

To facilitate the development of these guidance documents, the NRC Office of Nuclear Regulatory Research (RES) has been tasked by the NRC Office of Nuclear Reactor Regulation (NRR) with identifying and evaluating aging management of SSCs during a subsequent license renewal (SLR) period. Argonne National Laboratory (Argonne) is providing technical support to the NRC staff to develop guidance documents for technical review of applicant submittals for subsequent operation of NPPs beyond 60 years. As part of its work to support this guidance document development activity, the NRC is performing "AMP Effectiveness Audits" to provide an understanding of how AMPs have been implemented by plants during the PEO and the degradation that has been identified by the AMPs. The results from these audits will provide key information to aid the NRC in identifying needed changes to existing AMPs and new AMPs that may be needed to provide assurance of safe plant operation during an SLR operating period. The scope of these AMP Effectiveness Audits addressed:

- Understanding how the AMPs have been implemented by licensees during the PEO (e.g., the types of component inspections that have been conducted and any access impediments for the inspections)
- Reviewing the findings from the AMPs in terms of the types of degradation that have been identified
- Identifying how the AMPs have changed based on plant-specific and industry operating experience

This technical letter report (TLR) provides the staff's observations from the AMP Effectiveness Audits for mechanical systems, structures, and electrical systems at the Robert Emmett Ginna (Ginna) and Nine Mile Point Unit 1 (NMP-1) NPPs for the license renewal period of extended operation (PEO). The license renewal application (LRA) for Ginna was submitted on August 1, 2002, and the renewed license was issued on May 19, 2004, technically supported by the "Safety Evaluation Report Related to the License Renewal of the R. E. Ginna Nuclear Power Plant," issued as NUREG-1786. Ginna entered the PEO beyond 40 years on September 19, 2009. Similarly, NMP-1 submitted an LRA on May 27, 2004, and the renewed license was issued on October 31, 2006, technically supported by the "Safety Evaluation Report

Related to the License Renewal of Nine Mile Point Nuclear Station, Units 1 and 2," issued as NUREG-1900. NMP-1 entered its PEO on August 22, 2009.

Staff from NRR and RES conducted onsite audits in August/September 2011 at Ginna and in November 2011 at NMP-1. The staff reviewed the licensee's implementation of the AMPs and findings from the AMPs, including confirmatory findings of no degradation as well as adverse or unexpected aging effects. Among the areas considered by the staff during its audit activities were the following:

- Inspection accessibility issues, adequacy of inspection methods, and frequency of inspections
- Unanticipated structure and component degradation, related equipment failures, or premature repair/replacement
- Trending information that can yield insights regarding the actual effectiveness of the current AMPs and aging management reviews (AMRs)

The types of information reviewed by the audit team included the following:

- Available results of licensee health reports/assessments of the AMPs
- Sample results from the nonconformance reporting system related to plant aging
- Licensee evaluation of site-specific and industry operating experience
- Changes made to AMPs
- Any related information about the adequacy of the current AMPs that will assist in the development of guidance for SLR aging management processes and programs

The audits reviewed 29 mechanical system AMPs at Ginna and 30 mechanical system AMPs at NMP-1, and eight structural system AMPs and seven electrical system AMPs each at Ginna and NMP-1. In addition, three AMPs associated with time-limited aging analyses (TLAAs) were reviewed at Ginna and two at NMP-1. The audit process involved onsite interviews of licensee plant personnel by the staff, with additional participation by telephone by both the staff and, for the mechanical and structural AMPs, Argonne staff.

The license renewal applications for both Ginna and NMP-1 were based on the guidance of Revision 0 of NUREG-1800 (Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants, SRP-LR) and Revision 0 of NUREG-1801 (Generic Aging Lessons Learned (GALL) Report), and the AMPs for these two plants were generally prepared in conformance with this guidance. Accordingly, there is not a precise correlation between the AMPs currently listed in the latest version of the GALL Report, (NUREG-1801, Rev. 2), and those used and audited at Ginna and NMP-1. In addition, because Ginna is a pressurized water reactor (PWR) and NMP-1 is a Mark-1 boiling water reactor (BWR), the applicable AMPs are different for the two plants in some cases. The AMPs reviewed at Ginna include six plant-specific programs not contained in NUREG-1801, Rev. 0, three each related to mechanical and electrical systems, and the NMP-1 AMPs include seven plant-specific programs, two each related to mechanical and structural systems, and three to electrical systems.

This report provides the staff's observations from the AMP audits at Ginna and NMP-1, but does not make generic conclusions, as only two of the more than 100 operating plants are addressed herein. The results from these audits have been used to refine the approach for additional AMP Effectiveness Audits at other NPPs. The staff believes that the audit enhancements will widen its knowledge base and help enable the staff to draw conclusions toward the development of guidance documents for SLR.

Once sufficient information has been gathered from the AMP Effectiveness Audits at Ginna and NMP-1 and future audits, the information will be evaluated to identify:

- Aging effects that need to be managed during an SLR operating period
- Changes to existing license renewal AMPs to improve the performance of the AMPs for management of aging effects during the SLR operating period
- New AMPs that need to be added for the SLR operating period

Prior to issuance of this report the licensee for each plant was provided a draft of the report to ensure factual accuracy; significant comments provided by each licensee are noted in the report. We especially acknowledge the facilitation and review and comments on an earlier draft of this report by Michael Fallin, Constellation Energy Nuclear Group, LLC.

ACRONYMS AND ABBREVIATIONS

ACI	American Concrete Institute
Act	Atomic Energy Act of 1954, as amended
AMA	aging management activity
AMP	aging management program
AMR	aging management review
Argonne	Argonne National Laboratory
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
BMI	bottom-mounted instrumentation
BSS	borated stainless steel
BWR	boiling water reactor
BWRVIP	Boiling Water Reactor Vessels and Internals Project
CAP	corrective action program
CASS	cast austenitic stainless steel
CCCW	closed-cycle cooling water
CEDM	control element drive mechanism
CFR	Code of Federal Regulations
CLB	current licensing basis
CMTR	certified material test reports
Corps	U.S. Army Corps of Engineers
CR	Condition Report
CRD	control rod drive
CRDRL	control rod drive return line
CS	carbon steel
CUF	cumulative usage factor
CVCS	chemical volume and control system
ΔP/SLC	differential pressure and standby liquid control
DER	deviation event reports
DFP	diesel fire pump
DMIMS	digital metal impact monitoring system
DOE	U.S. Department of Energy
ECCS	emergency core-cooling system
ECP	electrochemical potential
EFPY	effective full power years
EMDA	expanded materials degradation assessment
ePIC	Electronic Performance Improvement Center
EPRI	Electric Power Research Institute

EPU	extended power uprate
EQ	Environmental Qualification
EVT-1	enhanced visual examination
FAC	flow-accelerated corrosion
FME	foreign material exclusion
FMP	Fatigue Monitoring Program
FOSAR	Foreign Object Search and Removal
FP	Fire Protection
FW	feedwater
FWS	fire water system
GALL	Generic Aging Lessons Learned (NUREG-1801)
GDC	general design criteria
GE	General Electric
Ginna	Robert Emmett Ginna nuclear power plant
GL	Generic Letter
GSI	Generic Safety Issue
HAZ	heat-affected zone
HPCI	high-pressure coolant injection
HVAC	heating, ventilation, and air conditioning
HWC	hydrogen water chemistry
IASCC	irradiation-assisted stress corrosion cracking
ID	inside diameter
IEB	Inspection & Enforcement Bulletin
IGA	intergranular attack
IGSCC	intergranular stress corrosion cracking
ILRT	integrated leak rate test
IN	Information Notice
INPO	Institute of Nuclear Power Operations
IP	inspection procedure
IPA	integrated plant assessment
IR	inspection report
ISI	inservice inspection
ISP	integrated surveillance program
LER	licensee event report
LOCA	loss of coolant accident
LR	license renewal
LRA	license renewal application
LRGD	license renewal guidance document

LR-ISG	license renewal interim staff guidance
LTO	long-term operation (i.e., operation beyond initial license namely beyond 40 years)
LTOP	low-temperature overpressure protection
MEB	metal-enclosed bus
MIC	microbiologically-influenced corrosion
MRP	Materials Reliability Program
NDE	nondestructive examination
NEI	Nuclear Energy Institute
NFPA	National Fire Protection Association
NMCA	noble metal chemical addition
NMP-1	Nine Mile Point Unit 1
NMPC	Niagara Mohawk Power Corporation
NPP	nuclear power plant
NRC	U.S. Nuclear Regulatory Commission
NRR	NRC Office of Nuclear Reactor Regulation
NSAC	Nuclear Safety Analysis Center
NSIAC	Nuclear Strategic Issues Advisory Committee
NSSS	nuclear steam supply system
OCCW	open-cycle cooling water
OD	outside diameter
OpE	operating experience
PBD	program basis document
PEO	PEO
PMDA	Proactive Materials Degradation Assessment
POCs	points of contact
PT	penetration test
P-T	pressure-temperature
PWR	pressurized water reactor
PWSCC	primary water stress corrosion
RAI	request for additional information
RCP	reactor coolant pump
RCS	reactor coolant system
RES	NRC Office of Nuclear Regulatory Research
RFO	refueling outage
RG	Regulatory Guide
RHR	residual heat removal
RIS	Regulatory Issue Summary
RLSB	NRC/NRR License Renewal and Standardization Branch

RPV	reactor pressure vessel
RVI	reactor vessel internals
RWCU	reactor water cleanup
SCC	stress corrosion cracking
SER	safety evaluation report
SFP	spent fuel pool
SG	steam generator
SLC	standby liquid control
SLR	subsequent license renewal
SOER	Significant Operating Experience Report
SRP-LR	Standard Review Plan for License Renewal (NUREG-1800)
SS	stainless steel
SSCs	systems, structures, and components
Staff	NRC staff
STP	Standard Test Procedures
SW	service water
TGSCC	transgranular stress corrosion cracking
TLAA	time-limited aging analysis
TLR	Technical Letter Report
TR	topical report
TS	technical specification
UT	ultrasonic testing
VT	visual (inspection) testing; VT-1 detects discontinuities/imperfections, VT-2 detects evidence of leakage, and VT-3 determines general mechanical and structural condition of components
WCAP	Westinghouse Commercial Atomic Power

SECTION 1

INTRODUCTION

In accordance with the Atomic Energy Act of 1954, as amended (Act), United States (U.S.) commercial nuclear power plants (NPPs) were granted an initial operating license for a 40-year term. Part 54 of Title 10 of the *Code of Federal Regulations* (10 CFR Part 54), “Requirements for Renewal of Operating Licenses for Nuclear Power Plants,” known as the license renewal rule, was adopted by the U.S. Nuclear Regulatory Commission (NRC) to provide the process for licensees to apply for renewal of their operating licenses for an additional 20 years of operation, and the NRC staff to evaluate the application and, if it meets the requirements of the rule, grant renewal of the license. The license renewal rule addresses the safety and technical requirements for the extended license term, and the renewal is based on the NRC’s assessment of the plant’s operational safety, including environmental protection, being assured during the 20-year period of extended operation (PEO). Neither the Act nor 10 CFR Part 54 preclude a licensee from requesting additional years beyond the 20-year PEO, and 10 CFR 54.31(d) states that “a renewed license may be subsequently renewed.”

“License renewal” (LR) is the process used in the U.S. for an NPP to request, using a license renewal application (LRA), renewal of the plant’s operating license for an additional 20 years of operation and the NRC staff to review and evaluate the acceptability of the LRA. The license may be renewed for an additional operating period up to 20 years. The term “subsequent license renewal” (SLR) refers to the second (or subsequent) renewal of a license that was previously renewed. For example, SLR may approve continued operation for the period from 60 to 80 years. SLR also refers to the process for applicants to submit an LRA for the staff to review and evaluate.

The term “period of extended operation” or PEO is used in 10 CFR 54.3 in the definition of “integrated plant assessment” (IPA). This term describes plant operation beyond the initial 40-year license term; for example, plant operation from 40 to 60 years under a renewed license, or equally the SLR PEO from 60 to 80 years. In addition, “long term operation” (LTO) is sometimes used in the U.S. to refer to NPP operation beyond the initial 40-year license period, and is used internationally to describe plant operation beyond the original design or license period.

Pursuant to 10 CFR Part 54, the staff has reviewed and approved, as of March 2013, 73 nuclear power reactor units for an additional 20 years of operation beyond the initial license period. Presently, the staff is reviewing 9 LRAs for 14 reactor units and expects that essentially all licensees with operating reactors will request an initial license renewal. Furthermore, as of March 2013, 18 plants have entered the PEO.

Based on public meetings with the Nuclear Energy Institute (NEI), some licensees are considering submitting applications for a subsequent license renewal period (i.e., for plant operation beyond 60 years). The first of these applications could possibly be submitted as early as 2017.

To ensure an orderly review of possible SLR applications, the NRC is developing guidance documents for the technical review of applications for subsequent license renewal, i.e., that would authorize plant operation beyond 60 years. The current license renewal guidance documents (LRGDs) used for the review of LRAs for operation up to 60 years are the “Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants” (NUREG-1800) and the Generic Aging Lessons Learned (GALL) Report (NUREG-1801). An important part of this LRGD development for SLR is the identification of aging effects for systems, structures, and components (SSCs) within the scope of the license renewal rule that would be important to consider for plant operation beyond 60 years, along with the development of aging management programs (AMPs) that will be effective in managing the identified aging effects.

To facilitate development of these LRGDs, the NRC Office of Nuclear Regulatory Research (RES) has been tasked by the NRC Office of Nuclear Reactor Regulation (NRR) to identify and evaluate aging management of SSCs during an SLR PEO. Argonne National Laboratory (Argonne) is providing technical support to the staff to develop LRGDs for technical review of applicant submittals for subsequent operation of NPPs beyond 60 years.

The approach to develop the necessary staff guidance documents builds upon the base developed for the review of initial LRAs, for operation to 60 years. The additional considerations for SLR, related to aging management reviews and aging management programs, include the following:

- Identify aging effects that require aging management during the SLR PEO, with an emphasis on new aging effects not previously considered for the initial LRAs, new locations of known aging effects, and aging effects that can become more severe during an SLR PEO.

- Develop AMPs to manage the aging effects identified for SLR PEO. These AMPs can be:

    - Existing AMPs developed to support the initial PEO

    - Modifications to existing AMPs to improve their effectiveness in managing the expected aging effects for the SLR PEO

    - New AMPs developed to address aging effects specific to the SLR PEO

As part of its work to support this LRGD development activity, the NRC is performing “AMP Effectiveness Audits” to provide an understanding of how AMPs have been implemented by plants during the PEO and the degradation that has been identified by the AMPs. The results from these audits will provide key information to aid the NRC to identify needed changes to existing AMPs and new AMPs that may be needed to provide assurance of safe plant operation during an SLR operating period. The scope of these AMP Effectiveness Audits addressed:

- Understanding how the AMPs have been implemented by licensees during the PEO (e.g., the types of component inspections that have been conducted and any access impediments for the inspections)

- Reviewing the findings from the AMPs in terms of the types of degradation that have been identified

- Identifying how the AMPs have changed based on plant-specific and industry operating experience

This technical letter report (TLR) provides the staff’s observations from the AMP Effectiveness Audits for mechanical systems, structures, and electrical systems for the Robert Emmett Ginna (Ginna) and Nine Mile Point Unit 1 (NMP-1) NPPs for the PEO. The LRA for Ginna was submitted on August 1, 2002, and the renewed license was issued on May 19, 2004, technically supported by the “Safety Evaluation Report Related to the License Renewal of the R. E. Ginna Nuclear Power Plant,” issued as NUREG-1786. Ginna entered the PEO beyond 40 years on September 19, 2009. Similarly, NMP-1 submitted an LRA on May 27, 2004, and the renewed license was issued on October 31, 2006, technically supported by the "Safety Evaluation Report Related to the License Renewal of Nine Mile Point Nuclear Station, Units 1 and 2," issued as NUREG-1900. NMP-1 entered its PEO on August 22, 2009.

The LRAs for both Ginna and NMP-1 were based on the guidance of Revision 0 of NUREG-1800 (Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants) and Revision 0 of NUREG-1801 (Generic Aging Lessons Learned (GALL) Report), and the AMPs for these two plants were generally prepared in conformance with this guidance. Although there is not a precise correlation between the AMPs currently listed in the latest version of the GALL Report (NUREG-1801, Rev. 2), and those used and audited at Ginna and NMP-1, the audit team used the GALL Report, Rev. 2 as an information source for the audits. It is recognized that the GALL Report provides just one avenue for implementing an acceptable AMP for managing the aging effects so that the intended functions of safety-significant SSCs are maintained during the PEO. A licensee may have taken some exceptions to the GALL Report AMP or identified enhancements either to make their plant-specific AMP consistent with the GALL Report AMP or to address plant-specific considerations, including operating experience, to ensure adequate aging management. Alternatively, the applicant may propose an alternative AMP and submit it for review and approval by the staff. Such changes are considered in the information reviewed during the audits.

This report provides the staff's observations from the AMP audits at Ginna and NMP-1, but does not attempt to draw extensive conclusions from these audits, as only two of the more than 100 operating plants are addressed herein. The results from these audits have been used to refine the approach to be taken for future AMP Effectiveness Audits, which will widen the knowledge base and enable broader conclusions to be drawn to support the development of LRGDs for SLR.

Once sufficient information has been gathered from the AMP Effectiveness Audits at Ginna and NMP-1 and future audits, the information will be evaluated to inform:

- Aging effects that need to be managed during an SLR operating period
- Changes to existing license renewal AMPs to improve the performance of the AMPs for management of aging effects during the SLR operating period
- New AMPs that need to be added for the SLR operating period

Chapter 2 of this report summarizes the staff's observations from the audits at Ginna and NMP-1 NPPs.

1.1 License Renewal Process

For operating NPPs, a license is renewed on the basis that the current licensing basis (CLB) continues to remain valid and additional measures are taken, identified as "aging management," such that the intended functions of the SSCs within the scope of license renewal are maintained during the PEO. 10 CFR 54.3 states:

> "Current licensing basis (CLB) is the set of NRC requirements applicable to a specific plant and a licensee's written commitments for ensuring compliance with and operation within applicable NRC requirements and the plant-specific design basis (including all modifications and additions to such commitments over the life of the license) that are docketed and in effect. The CLB includes the NRC regulations contained in 10 CFR parts 2, 19, 20, 21, 26, 30, 40, 50, 51, 52, 54, 55, 70, 72, 73, 100 and appendices

> thereto; orders; license conditions; exemptions; and technical specifications. It also includes the plant-specific design-basis information defined in 10 CFR 50.2 as documented in the most recent final safety analysis report (FSAR) as required by 10 CFR 50.71 and the licensee's commitments remaining in effect that were made in docketed licensing correspondence such as licensee responses to NRC bulletins, generic letters, and enforcement actions, as well as licensee commitments documented in NRC safety evaluations or licensee event reports."

10 CFR 54.33(b) states, in part, that:

> "Each renewed license will be issued in such form and contain such conditions and limitations, including technical specifications, as the Commission deems appropriate and necessary to help ensure that systems, structures, and components subject to review in accordance with § 54.21 will continue to perform their intended functions for the PEO. In addition, the renewed license will be issued in such form and contain such conditions and limitations as the Commission deems appropriate and necessary to help ensure that systems, structures, and components associated with any time-limited aging analyses will continue to perform their intended functions for the PEO."

The license renewal process is initiated with the receipt and docketing of an LRA. An LRA contains an IPA and an evaluation of time-limited aging analyses (TLAAs), as defined in 10 CFR 54.21(c). As described in 10 CFR 54.21(a), the IPA is a licensee assessment that demonstrates that a nuclear power plant facility's structures and components requiring aging management review (AMR), in accordance with scope of license renewal, have been identified and that the effects of aging on the functionality of such structures and components will be managed to maintain the CLB such that there is an acceptable level of safety during the PEO. 10 CFR 54.21(a)(3) further states that, for each structure and component identified as in scope for license renewal, the IPA shall demonstrate that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the PEO.

From the perspective of demonstrating that the effects of aging will be adequately managed during the PEO, the essential elements of the AMR described in 10 CFR 54.21 involve:

- Identifying the SSCs within the scope of license renewal
- For those SSCs identified above, identifying the aging effects that require aging management
- Identifying the aging management that will ensure the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the PEO

The aging effects that require aging management depend on the materials used to fabricate the components and structures, fabrication method used, and the service conditions of the SSCs, such as temperature, reactor coolant water chemistry, cumulative neutron irradiation dose, imposed stress and other environmental factors, and their fluctuations during service. As an example for mechanical components, the applicable aging effects and degradation mechanisms include, but are not limited to: (a) material loss due to corrosion, corrosion/erosion, or wear; (b) cracking due to fatigue, intergranular stress corrosion cracking (IGSCC), transgranular stress corrosion cracking (TGSCC), primary water stress corrosion cracking (PWSCC), or irradiation-assisted stress corrosion cracking (IASCC); (c) reduction in fatigue life due to aqueous environmental effects; (d) loss of ductility and fracture toughness due to void formation, neutron irradiation and/or thermal embrittlement, including synergistic effects of neutron/thermal embrittlement; (e) loss of preload due to thermal and/or irradiation enhanced stress relaxation; and (f) change in dimension due to void swelling. Some of these effects may involve TLAAs that may not have been significant during the initial 40- or 60-year service and, therefore, are not included in the design basis analyses or the plant's technical specifications.

As quoted from Appendix A.1 of the Standard Review Plan for License Renewal (SRP-LR), the Branch Technical Position RLSB-1 is that *"the license renewal process is not intended to demonstrate absolute assurance that structures and components will not fail, but rather that there is reasonable assurance that they will perform such that the intended functions are maintained consistent with the current licensing basis (CLB) during the PEO."* Furthermore, a program based solely on detecting structure and component failure is not considered an effective AMP for license renewal. An effective management of aging degradation is achieved by means of a comprehensive AMP that consists of several aging management activities (AMAs). Further details of the AMR process and a description of the 10 elements of an acceptable AMP are presented in the Branch Technical Position RLSB-1 in Appendix A.1 of the SRP-LR.

SECTION 2

IMPLEMENTATION AND PERFORMANCE OF AMPS AT GINNA AND NMP-1

As stated above, the renewed operating license for Ginna was issued on May 19, 2004, and the plant entered the PEO beyond 40 years on September 19, 2009. NMP-1 was issued a renewed license on October 31, 2006, and it entered the PEO on August 22, 2009. Onsite audits of these two plants were conducted by the staff in August/September 2011 for Ginna and in November 2011 for NMP-1 to evaluate the implementation and effectiveness (or adequacy) of their first renewal AMPs in order to provide guidance for SLR.

2.1 <u>Audit Scope and Implementation</u>

The scope of these AMP Effectiveness Audits addressed:

- Understanding how the AMPs have been implemented by licensees during the PEO (e.g., the types of inspections that have been conducted and any access impediments for the inspections)

- Reviewing the findings from the AMPs in terms of the types of degradation that have been identified

- Identifying how the AMPs have changed based on plant-specific and industry operating experience

The staff reviewed associated licensee information regarding the implementation of both one-time and periodic AMPs. The staff assessed the licensee findings, including both adverse or unexpected aging as well as confirmatory or anticipated aging. Among the areas considered by the staff during its audit activities were the following:

- Inspection accessibility issues, adequacy of inspection methods, and frequency of inspections
- Unanticipated structure and component degradation, related equipment failures, or premature repair/replacement
- Trending information that can yield insights regarding the actual performance of the current AMPs and AMRs

The types of information reviewed by the audit team included the following:

- Available results of licensee health reports/assessments of the AMPs
- Sample results from the nonconformance reporting system related to plant aging
- Licensee evaluation of site-specific and industry operating experience
- Changes made to AMPs (see Table 2.1 for a description of the 10 Elements of an acceptable AMP, as adapted from Table A.1-1 of the SRP-LR)
- Any related information about the adequacy of the current AMPs that will assist in the development of guidance for SLR aging management processes and programs

Table 2.1 Elements of an Aging Management Program for License Renewal	
Element	**Description**
Program Description	Summary, in no more than a few paragraphs, of the aging effect(s) to be managed, the aging mechanism(s) responsible for the aging effect(s), the overall approach proposed to manage the aging effect(s), and the technical basis for this approach.
1. Scope of Program	Scope of program includes the specific structures and components subject to an AMR for license renewal.
2. Preventive Actions	Preventive actions should prevent or mitigate aging degradation.
3. Parameters Monitored or Inspected	Parameters monitored or inspected should be linked to the degradation of the particular structure or component-intended function(s).
4. Detection of Aging Effects	Detection of aging effects should occur before there is a loss of structure or component-intended function(s). This includes aspects such as inspection method or technique (i.e., visual, volumetric, surface inspection), frequency, sample size, data collection, and timing of new/one-time inspections to ensure timely detection of aging effects.
5. Monitoring and Trending	Monitoring and trending should provide predictability of the extent of degradation, and timely corrective or mitigative actions.
6. Acceptance Criteria	Acceptance criteria, against which the need for corrective action will be evaluated, should ensure that the structure or component-intended function(s) are maintained under all CLB design conditions during the PEO.
7. Corrective Actions	Corrective actions, including root cause determination and prevention of recurrence, should be timely.
8. Confirmation Process	Confirmation process should ensure that preventive actions are adequate and that appropriate corrective actions have been completed and are effective.
9. Administrative Controls	Administrative controls should provide a formal review and approval process.
10. Operating Experience	If the AMP is an existing program, operating experience of the AMP, including past corrective actions resulting in program enhancements or additional programs, should provide objective evidence to support the conclusion that the effects of aging will be managed adequately so that the structure- and component-intended function(s) will be maintained during the PEO.
References	References for AMP citations and to NRC (and other, as appropriate) guidance should provide enough information to apply the above ten elements.

2.2 Results of the AMP Audits

This chapter summarizes the observations on the AMPs identified during the two AMP effectiveness audits. The observations are presented for each of the AMPs reviewed during the audits in the context of the AMPs in GALL Report, Rev. 2, since the development of guidance documents for SLR will use the GALL Report, Rev. 2, as a starting point. In some cases, the Ginna and NMP-1 AMPs differ from those in the GALL Report, Rev. 2, either because they were based on GALL Report, Rev. 0, guidance, the licensee identified exceptions or enhancements, or the licensee made use of a plant-specific AMP. The differences between the AMPs implemented at the audit plants and those in GALL Report, Rev. 2 guidance are noted in the discussions.

The Appendix gives more details of the actual AMP Effectiveness Audits. The key points of contact (POCs) during the Ginna audit and the correlation between the audited Ginna AMPs and the corresponding GALL AMPs are shown in Table A.1 and A.2. The key POCs during the NMP-1 audit and the correlation between the audited NMP-1 AMPs and the corresponding GALL AMPs are shown in Table A.3 and A.4. The differences between GALL Rev. 2 AMPs and those implemented at the audited plants are summarized in Table A.5.

2.3 AMPs for Mechanical Systems

This section describes the AMPs related to mechanical systems (also see Table A.5), including the 38 AMPs numbered XI.M1 through XI.M41 in Chapter XI of the GALL Report, Rev. 2, and one AMP associated with management of TLAAs related to metal fatigue (X.M1 "Fatigue Monitoring"). The program description of the AMP summarizes, in no more than a few paragraphs, the aging effect to be managed, the aging mechanism(s) responsible for this effect, the overall approach proposed to manage this aging effect, and the technical basis for this approach. In general, the program descriptions provided in the Ginna and NMP-1 AMPs for mechanical systems, which were prepared under GALL Report, Rev. 0, guidance, met these objectives. Furthermore, the SRP-LR, Rev. 2, states that Element 1 of AMPs should identify the specific structures and components that are subject to an AMR. The Ginna and NMP-1 AMPs generally satisfied this provision as well. Table A.5 illustrates the relationship between the mechanical AMPs as reviewed during the Ginna and NMP-1 audits.

2.3.1 XI.M1 ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD

Ginna implements this program through its AMP B2.1.2, "ASME Section XI, Subsections IWB, IWC, & IWD Inservice Inspection," and NMP-1 through its AMP B2.1.1, "ASME Section XI Inservice Inspection (Subsections IWB, IWC, IWD) Program." These programs are existing programs to ensure compliance with the requirements of 10 CFR 50.55a.

The Ginna LRA states that its program is consistent with AMP XI.M1 of the GALL Report, Rev. 0, with no exceptions or enhancements. It further states that its inservice inspection (ISI) program is continually upgraded to account for industry experience and research and is subject to periodic NRC inspections and self-assessments. Ginna has been approved for risk-informed inservice inspection for the plant's 5^{th} inspection interval, which began in 2010 and utilizes the 2004 ASME Code. The licensee described various approved ASME Code cases that they utilize, such as N-307-3 related to reactor vessel head closure studs. In response to a question, the Ginna staff stated that one change they would recommend to the GALL Report would be greater specificity and clarity to the AMP on the non-Code inspections that are included in the AMP.

The NMP-1 LRA states that the applicant takes exception to the corresponding GALL Report, Rev. 0, AMP in that examination categories B-F, B-J, C-F-1, C-F-2 and IGSCC Category A are inspected using the Electric Power Research Institute (EPRI) risk-informed methodology and implemented in accordance with ASME Code Case N-578-1, as approved by NRC plant-specific Relief Request. In addition, NMP-1 noted its related commitment to implement ASME Code Case N-730, "Roll Expansion of Class 1 Control Rod Drive Bottom Head Penetrations in BWRs," to eliminate leakage.

The NMP-1 audit found that the licensee performs a quarterly health report that includes a review of the related industry operating experience (OpE) and incorporates the findings into its inspection plans, which is potentially important for an ISI program based mainly on a consensus set of ASME code requirements. The risk-informed part of the ISI program at NMP-1 also requires a review of OpE. NMP-1 has voluntarily committed to additional inspections of the NMP-1 reactor vessel and internals per Boiling Water Reactor Vessels and Internals Program (BWRVIP) guidelines. These additional inspections are outside the scope of the ASME Section XI Code requirements.

It was noted during the audits that plant-specific considerations, such as any risk-informed ISI, relief requests, and in the case of BWRs, some BWRVIP requirements, are likely to impact the scope and requirements of ASME Section XI ISI implementation.

The staff noted that NMP-1's request for permanent relief from examining reactor pressure vessel (RPV) circumferential welds and its proposal to perform only two to three percent of the circumferential welds that intersect longitudinal welds, for the extended period of operation, was approved by NRC on April 3, 2009. The staff determined that NRC approved, on March 15, 2010, NMP-1's relief request to implement the risk-informed/safety-based ISI program for the Code Class 1 and 2 piping system.

The staff noted that in response to leakage through the lower head of the NMP-1 reactor vessel penetrations for the control rod drive (CRD) mechanisms, repairs have been made by roll expanding the CRD housing in order to stop or limit the reactor coolant leakage. The staff also noted that, during the LRA process, NMP-1 was mandated to commit to implement ASME Code Case N-730, and that an ultrasonic testing (UT) examination of the roll-expanded CRD housing shall be performed in accordance with the code case on at least 10 percent of previously rolled housing during each inspection interval.

The staff's review of plant-specific operating experience of NMP-1 revealed deviation event reports ([DERs] which have since been re-termed Condition Reports [CRs]) documenting indications of flaws in recirculation components, piping, and various nozzle connection welds. The staff noted that deficiencies identified by the applicant's ASME Section XI ISI program have been repaired, replaced, or evaluated in accordance with ASME Section XI and NMP-1 implementing procedures. The staff further noted that three non-conforming issues were identified during the prior refueling outage (RFO 21) at NMP-1. The first was a relevant condition associated with the steam dryer support brackets. The second was a flaw in the reactor vessel head to flange weld. The third was damaged threads on a nut removed from a valve. The reactor vessel head-to-flange flaw exceeded the acceptance criteria of IWB-3510 (the indication was subsurface, 1.129 inches in the through-wall dimension and 79 inches long), which has been determined to be an original fabrication defect. The staff noted that the licensee performed a flaw evaluation determining that the indication was acceptable for continued operation, and the evaluation was submitted to NRC for approval on June 28, 2011.

During the NMP-1 audit, the staff also noted that the current ISI program has been tracking eight previously identified flaw indications that were conditionally accepted by analytical evaluation and subsequently approved by the NRC, for which flaw re-examination will continue to be performed as required by ASME code.

2.3.2 XI.M2 Water Chemistry

Ginna implements this program through its AMP B2.1.37, “Water Chemistry Control,” and NMP-1 through its AMP B2.1.2, “Water Chemistry Control Program.” The Ginna LRA states that its program is consistent with AMP XI.M2 of the GALL Report, Rev. 0, with the exception that it uses updated editions of the EPRI primary and secondary water chemistry control guidelines. The Ginna LRA cites EPRI Topical Report (TR) TR-105714, Rev. 4, for primary systems chemistry and EPRI TR-102134, Rev. 5, for secondary systems chemistry.

During the Ginna audit, it was noted that the licensee performs monthly self-assessments on both primary and secondary water chemistry as a part of the water chemistry program. With the information obtained, repetitive findings are identified and tracked. The results of such monthly self-assessments provide a basis for the continued improvement of program performance. Ginna implemented a 17 percent power uprate at the beginning of Cycle 33 (fall of 2006). During the subsequent Cycle 34 (beginning in the spring of 2008), iron transport was a little higher as indicated by a review of primary and secondary chemistry. During Cycle 34, approximately 89 lb. of iron oxides were transported by the feedwater (FW) to the steam generators. At the time of the AMP audit, only limited OpE (a few operating cycles) was available with respect to the possible effects of power uprate on water chemistry control.

NMP-1 likewise took an exception to the GALL Report in that, when the EPRI or BWRVIP water chemistry guidance document cited in the GALL Report is updated, it uses the updated document. The amended LRA cites EPRI TR-103515, Rev. 1 and 2. In addition, the NMP-1 program takes an exception in that electrochemical potential (ECP) is monitored only under hydrogen water chemistry (HWC) operation, and it also takes exception to the GALL Report, Rev. 0, recommendation for monitoring of hydrogen peroxide. The licensee justifies the latter exception because accurate measurement of this chemical is extremely difficult due to its rapid decomposition in the sample lines. As an alternative, it monitors the molar ratio of hydrogen to oxygen, consistent with EPRI TR-103515, Rev. 2. As noted in NUREG-1950, Table IV-12, Element 3 of this AMP was changed in GALL Report, Rev. 2, to be consistent with the most recent EPRI BWR Water Chemistry Guidelines (BWRVIP-190, EPRI 1016579).

A review of water chemistry OpE at NMP-1 during the audit revealed problems in implementing HWC. The noble metal chemical application and zinc FW additions programs have been operating as expected. The licensee subsequently noted that the problems with the HWC had been primarily due to the hydrogen supply line. This issue has been resolved and the system now operates with approximately 98 percent availability, which meets the industry guidelines. Ginna also reported water chemistry control problems. The problems generally involved levels of specific impurities exceeding EPRI guidelines, particularly during startup and transient operating conditions, which are common responses of the plant, and are being addressed in the corrective action program.

2.3.3 XI.M3 Reactor Head Closure Stud Bolting

Ginna implements this program through its AMP B2.1.25, “Reactor Head Closure Studs.” The Ginna LRA states that the ISI portion of this program is included in its AMP B2.1.2, “ASME Section XI, Subsections IWB, IWC, & IWD Inservice Inspection.” As discussed in the SER for Ginna license renewal, the studs are fabricated with a specified minimum yield strength level of 105 ksi. Therefore, the actual yield strength levels of the closure studs may be greater than 150 ksi. Since stud materials with yield strength greater than or equal to 150 ksi are susceptible to stress corrosion cracking, cracking due to stress corrosion cracking is an applicable aging effect of the licensee's reactor head closure studs to be managed.

In order to minimize the potential for stress corrosion cracking, the licensee's Quality Assurance Program prohibits the use of lubricants containing molybdenum disulfide, which can promote stress corrosion cracking. In addition, the inservice inspection in accordance with ASME Code Section XI performs periodic volumetric examinations of the reactor head closure studs, which have been capable of detecting and managing cracks in the bolting components.

Based on its review of OpE, Ginna generates and reviews program health reports for the ASME Section XI ISI Program, which includes inspections of the reactor head closure studs. The purpose of these reports is periodic assessment and improvement of program performance. The licensee also indicated that these health reports have not identified a significant concern related to this program.

NMP-1 implements this program through its AMP B2.1.3, "Reactor Head Closure Studs Program," which is consistent with the GALL program. The audit found that no aging-related degradation occurred in the NMP-1 closure stud assemblies.

2.3.4 XI.M4 BWR Vessel ID Attachment Welds

This AMP is not applicable to Ginna, since it is a PWR. NMP-1 implements this program through its AMP B2.1.4, "BWR Vessel ID Attachment Welds Program." The NMP-1 LRA states that this program is consistent with AMP XI.M4 of the GALL Report, Rev. 0, but it also states that the program is implemented through AMP B2.1.8 (BWRVIP-48-A) for managing specific aging effects/mechanisms. Thus there were closely-related commitments. An example is Commitment #37 in which an enhanced visual examination, EVT-1, of the NMP Unit 2 feedwater sparger end bracket welds will be added to NMP AMP B2.1.8. Furthermore, the attributes of the BWR Vessel ID (inside diameter) Attachment Welds Programs related to maintaining reactor coolant water chemistry are discussed in the program description for the NMP-1 "Water Chemistry Control Program" (AMP B2.1.2).

The NMP-1 audit found that, during the spring 2011 refueling outage (N1R21), EVT-1 of the steam dryer support brackets revealed relevant indications (cracks or crack-like defects) in the heat-affected zone (HAZ) of three of the four brackets (made of high-C A240 Type 304 stainless steel [SS]). The cause of indications was identified as IGSCC, possibly due to residual stresses in the weld-sensitized bracket and applied dryer deadweight loads. As part of its acceptance criteria/corrective actions, the licensee recommended re-inspection during the N1R22 outage and revision of the flaw evaluation procedure to incorporate clear acceptance criteria for re-examination and to demonstrate the retention of adequate margin between N1R21 as-found indication data and the allowable criteria. If no changes in cracking are evident, then successive EVT-1 exams will be performed in subsequent outages, and if any significant change in cracking is apparent, a repair will be developed for implementation during N1R23.

2.3.5 XI.M5 BWR Feedwater Nozzle

This AMP is not applicable to Ginna, since it is a PWR. NMP-1 implements this program through its AMP B2.1.5, "BWR Feedwater Nozzle Program," and its ISI program. It was noted during the audit that UT and dye penetrant test (PT) inspections required by NUREG-0619, as recommended by the GALL Report, have been superseded, because the inspections are now performed in accordance with ASME Code Section XI, Appendix VIII per 10 CFR 50.55a. With respect to OpE, the LRA states that NMP-1 detected significant feedwater (FW) nozzle cracking in 1977. Repairs were performed per ASME Code Case N-504-1, as endorsed by NRC

Regulatory Guide (RG) 1.147, "Inservice Inspection Code Case Acceptability, ASME Section XI Division 1." A liquid PT examination of one FW nozzle performed in 1981 showed that no new cracks had been identified since the 1977 inspection and repairs. To minimize the potential for fatigue crack initiation, modifications meeting the requirements NUREG-0619 (including cladding removal, improved thermal sleeve/FW sparger design, rerouting of reactor water cleanup piping to the FW line, and improved FW flow control) were completed for the NMP-1 FW system. A series of calculations was performed to evaluate stress, fatigue usage factor, and crack growth of an assumed flaw projected to the end of life of the plant (40 years) as a function of number of operating cycles; these analyses formed the basis for the enhanced ISI program for the FW nozzle implemented at NMP-1. During the 1999 refueling outage (RFO15), an inservice UT of the four FW nozzles discovered no reportable indications. Visual examinations of the feedwater sparger as per NUREG-0619, performed in 2005 (RFO18) in accordance with NMPNS procedures, identified no recordable indications. Subsequently in 2007 (RFO19), welds were ultrasonically examined and were found acceptable. The next UT examination of the welds is scheduled to be performed during RFO 24.

In 1999, the original stress, fatigue, and crack growth analyses were revised to meet the requirement to use the updated ASME code fatigue curves and to incorporate changes in fatigue cycle definitions (magnitude and frequency of load cycles) based on updated plant data assumptions. These calculations include assumptions on numbers of transients occurring over a 1-year period, and a determination of the low-cycle fatigue usage factor for the FW system nozzles. Based on an anticipated number of startup/shutdown/scram cycles per year, annual fatigue usage factor was calculated to be 0.003 per year.

2.3.6 XI.M6 BWR Control Rod Drive Return Line Nozzle

This AMP is not applicable to Ginna, since it is a PWR. NMP-1 implements this program through its AMP B2.1.37, "BWR Control Rod Drive Return Line Nozzle Program." The NMP-1 LRA states that this program is consistent with AMP XI.M6 of the GALL Report, Rev. 0, with three exceptions. The first exception involves the edition of the ASME code used as the basis for the Section XI requirements. AMP XI.M6 of the GALL Report, Rev. 0, identifies the 1995 edition (including the 1996 addenda) of ASME Section XI as the basis for the GALL Report CRD return line (CRDRL) nozzle program. The NMP ISI program is updated to the latest edition and addenda of ASME Section XI, as mandated by 10 CFR 50.55a, prior to the start of each inspection interval and is therefore acceptable. The second and third exceptions involve the inspection method and frequency for performing the augmented inspection requirements in NUREG-0619. In lieu of PT examination every sixth refueling outage or 90 startup/shutdown cycles, whichever comes first, NMP-1 performs enhanced ultrasonic examination every 10 years. A CRDRL nozzle crack growth fracture mechanics analysis was used to demonstrate the adequacy of the 10 year inspection frequency. The NRC staff noted that, since the fracture mechanics analysis may form a basis for establishing the nozzle reinspection interval, it should be re-visited accordingly.

It was noted during the audit that no cracking was found during PT examinations of the NMP-1 CRDRL nozzle in 1977 or during subsequent examinations. During RFO15, an inservice UT of the CRDRL nozzle discovered no reportable indications (attachment to letter from Niagara Mohawk Power Corporation (NMP1L 1489) to NRC dated December 13, 1999). A welded-in-place thermal sleeve design makes the NMP-1 CRDRL nozzle less susceptible to thermal fatigue cracking than the original designs at other BWRs. In 1994, an analysis evaluating crack growth for an assumed flaw in the CRDRL nozzle showed that small surface flaws would not grow to unacceptable values within the original 40-year license period.

The CRD return line safe-end and the thermal sleeve were replaced in 1978 with modified design to improve resistance to both IGSCC and fatigue cracking. The replacement thermal sleeve material is low-carbon Type 316L SS, and the thermal sleeve is welded to the safe-end with low-carbon Type 308L weld filler. To reduce the probability of fatigue cracking, the thermal sleeve pipe protrudes 7 inches from the flow shield, which promotes mixing away from the vessel wall, thus preventing thermal cycling at the vessel wall and at the flow shield.

2.3.7 XI.M7 BWR Stress Corrosion Cracking

This AMP is not applicable to Ginna, since it is a PWR. NMP-1 implements this program through its AMP B2.1.6, “BWR Stress Corrosion Cracking Program.”

The BWR SCC Program is primarily a condition monitoring program. Maintaining high water purity reduces susceptibility to SCC or IGSCC. A review of the licensee’s program self-assessment reports indicates that the HWC system may not be meeting industry goals for HWC control. Further discussion of the licensee’s actions to address this is provided in Section 2.3.2, “XI.M2 Water Chemistry,” of this report.

NMP-1 OpE in general indicates that sulfate spikes occurred in the reactor coolant system due to resin release (intrusions) from demineralizers. High sulfate levels have the potential to significantly accelerate SCC of BWR piping during and subsequent to such intrusions. If demineralizer resin intrusions occur repeatedly and their effects are allowed to accumulate, the effects on aging can be significant over the current and subsequent PEOs. After the audit, the licensee provided the information that NMP-1 installed iron pre-filters which has significantly reduced the frequency of resin intrusions/sulfate transients.

The AMP was successful in detecting cracks from the welds within the scope of the program. The licensee also concluded that after successive examinations of the flaws in the recirculation system, the geometry and the size of the flaws had not changed essentially from the previous examination results. Therefore, the licensee has concluded that the flaws are not due to SCC, but fabrication-related.

2.3.8 XI.M8 BWR Penetrations

This AMP is not applicable to the Ginna because it is a PWR. The NMP-1 BWR Penetrations Program manages the effects of cracking due to SCC in the various penetrations of the reactor pressure vessels made of stainless steel, and nickel alloy. This program is based on guidelines issued by the BWRVIP and approved by the NRC. The attributes of the BWR Penetrations Program related to maintaining reactor coolant water chemistry are included in the Water Chemistry Control Program (amended LRA Section B2.1.2). The BWR Penetrations Program performs inspections and flaw evaluations in accordance with approved BWRVIP-49 and BWRVIP-27. In addition, the inspection and flaw evaluation for lower plenum components are performed in accordance with BWRVIP-47 as part of the BWRVIP program.

During the NMP-1 audit, the staff noted that, based on the BWRVIP-27 guidance, the licensee’s program for the penetration-to-safe-end weld of the core differential pressure and standby liquid control (ΔP/SLC) nozzles with stainless steel safe ends recommends an enhanced VT-2 inspection until a qualified UT is available. Furthermore, the feasibility of an appropriate volumetric examination for the ΔP/SLC nozzle locations is being evaluated.

The NMP-1 OpE indicates that the Unit 1 CRD stub tubes have experienced IGSCC cracking due to furnace-sensitized austenitic stainless steel fabrication. The licensee indicated that the system leakage test per the ASME code is performed during every refueling outage, and “best effort inspections" are performed for the stub tubes because they are not accessible during the normal refueling outage activities. During the last 18 years of operation, cracks and leakage have been detected in the CRD stub tubes using EVT-1 and VT-2 examinations, respectively. The exception was stub tube 50-19 in which EVT-1 did not identify cracking even though VT-2 examination had detected leakage from the stub tube.

Repairs of the cracked or leaking stub tubes have been made by roll expanding the CRD housing. The licensee stated that following roll repairs, a zero leakage condition has been observed in all cases. To date, 33 CRD penetrations have been roll expanded to a nominal 4 percent wall thinning. Of these, only one penetration (50-19) has been re-roll expanded to 6 percent wall thinning due to repeated occurrence of leakage. No leakage has been observed at this penetration since it was last roll expanded in 2005.

In relation to the implementation of HWC, the staff noted that the licensee's July–September 2011 program health report for the BWR Water Chemistry Program indicated that the HWC system was not meeting the industry goal of 98 percent availability. Further discussion of the licensee's actions to address this is provided in Section 2.3.2, "XI.M2 Water Chemistry," of this report.

2.3.9 XI.M9 BWR Vessel Internals

This AMP is not applicable to Ginna because it is a PWR. The NMP-1 BWR Vessel Internals Program B2.1.8 is an existing program that is consistent with the recommendations of AMP XI.M9 of the GALL Report, Rev. 0. In the LRA NMP-1 committed to enhance the BWR Vessel Internals Program to address the following:

- The BWRVIP-18 open item regarding inspection of inaccessible welds for core spray system. As such, NMP-1 will implement the resolution of this open item as documented in the BWRVIP response, once they are reviewed and approved by the NRC.
- The inspection and evaluation guidelines for steam dryers are currently under development by the BWRVIP committee. Once these guidelines are documented, and reviewed and approved by the NRC, the actions will be implemented in accordance with the BWRVIP program.
- The baseline inspections recommended in BWRVIP-47 for the BWR lower plenum components will be incorporated into the appropriate program and implementing documents.
- A schedule for additional inspections of the top guide locations (using EVT-1 or techniques demonstrated to be appropriate in BWRVIP-03) will be incorporated into the appropriate program and implementing documents. A minimum of 10 percent of the locations will be inspected within 12 years of the beginning of the PEO, with at least 5 percent of the inspections completed within 6 years.

As mentioned in AMP XI.M9 of the GALL Report, Rev. 2, BWRVIP-58-A provides guidelines for repair design criteria for the CRD housing. NRC/NRR is reviewing the modified BWRVIP-58 repair methodology that has been submitted. Since the audit, NMP-1 has approved and budgeted the contingency for a CRD stub tube leak weld repair, if needed, during the 2013 RFO.

Also, NMP-1 committed to enhance AMP B2.1.8 to manage the effects of loss of fracture toughness due to thermal aging and neutron embrittlement on the structural and functional integrity of potentially susceptible cast austenitic stainless steel (CASS) components. In addition, an EVT-1 examination of the NMP-1 FW sparger end bracket welds will be performed.

The inspection scope and frequency of the end bracket weld inspection will be the same as the ASME Section XI inspection of the FW sparger bracket vessel attachment welds.

The site-specific OpE at NMP-1 includes core shroud cracking, shroud support weld cracking, CRD stub tube cracking due to IGSCC and leakage, and top guide cracking. Although some events occurred prior to the 2004 LRA and the 2009 PEO entry, they are included here for general background.

Core Shroud Horizontal Weld Crack: NMP-1 identified core shroud horizontal weld cracking following the BWRVIP-01 baseline inspection in 1995. The corrective action taken was to install a pre-emptive core shroud tie-rod repair, which followed the BWRVIP-02 shroud repair guidelines.

Core Shroud Vertical Weld Crack: NMP-1 identified core shroud vertical weld cracking in 1997 following a baseline inspection required by BWRVIP-02 guidelines. A pre-emptive repair was installed in 1999 for the core shroud vertical welds using vertical weld clamps. NMP-1 has also identified indications in the core shroud support H9 vessel attachment weld during baseline BWRVIP-38 inspections in 2001. The indications were analyzed consistent with BWRVIP-38 methods and judged to remain acceptable considering a 10-year re-inspection frequency. Supplemental inspections on a sampling basis have been performed that have shown the indications are confined to the weld with no propagation into the vessel low alloy steel. The 2009 core shroud vertical inspection has demonstrated that no new vertical weld cracking has occurred. The inspection, however, has shown that the cracks in the V9 and V10 welds have continued to grow in depth and are effectively through-wall. This condition is bounded by the design assumption used for the vertical weld clamps on V9 and V10.

Top Guide Grid Beam Baseline Inspection: The inspection of the top guide performed in refueling outage 18 (April 2005) was a UT of approximately 100 percent of the accessible grid beam using the General Electric (GE) top guide grid beam UT tool. The inspection results identified similar indications as found in the 1996 inspection of the Oyster Creek top guide inspection. Based on the BWRVIP-26-A evaluation and the boat sample testing of the Oyster Creek top guide crack sample, the most likely cause of the indications is IASCC. The best estimate neutron fluence for the top guide was 4.4×10^{21} n/cm^2 at the time of the top guide UT performed in 2005. This fluence level is well above the IASCC threshold of 5×10^{20} n/cm^2. The UT results were analyzed and the licensee determined that the top guide would remain operable for continued service without restrictions. This analysis justifies a re-inspection frequency of 10 years.

License Renewal Top Guide Grid Beam Inspection: The re-inspection scope and frequency for the grid beam going forward will be based on BWRVIP-26A guidance for plant-specific flaw analysis and crack growth assessment. The maximum re-inspection interval for the grid beam will not exceed 10 years consistent with standard BWRVIP guidance for the core shroud. The re-inspection scope will be equivalent to that used in the UT baseline inspection during refueling outage 18 (2005). In addition, the re-inspection will include EVT-1 inspection of at least two locations with accessible indications within the initial 6 years of the 10-year interval. The intent of the EVT-1 is to monitor the known cracking to confirm flaw analysis crack growth assumptions. Per discussion with the AMP program owner, UT of the top guide will be repeated in refueling outage 22 (2015).

Core Spray Annulus Piping: The welds were examined during refueling outages 14, 15, and 16 (1997, 1999, and 2001, respectively) in accordance with BWRVIP-18. No cracking was identified in the creviced or P3A welds. The welds were visually re-examined per BWRVIP-18-A in refueling outage 19 (2007) and no indications were identified. In refueling outage 20 (2009), an indication in weld P6-U3A was identified. During refueling outages 18-20 (2005, 2007, and

2009), various Condition Reports (CRs) were initiated to identify poor visual inspection coverage due to access limitations. License Renewal Commitment 13 requires NMP-1 to implement the BWRVIP resolution of inaccessible welds for the core spray system. This license renewal commitment was completed based on NMP-1's commitment to implement the new/revised BWRVIP requirement.

The above deficiencies identified by the BWRVIP program activities have been repaired, replaced, or evaluated per BWRVIP program guidelines and station implementing procedures. The following adverse trends and NMP-1 responses were identified in the program health report:

- Newly identified cracking on the dryer support brackets required monitoring and contingency repair planning.
- Implementation HWC in service at low power is scheduled for 2013 outage to mitigate growth of pre-existing in-vessel cracks.
- The long term significance of continued growth of cracks in core shroud vertical welds V9 and V10 indicates effective crack flanking by noble metal chemical addition (NMCA) at NMP-1 (where crack flanking is the result of crack extension that can occur in NMCA plants during periods with hydrogen off or even during more extended periods with hydrogen on (BWRVIP-219, EPRI TR-1019071)).

2.3.10 XI.M10 Boric Acid Corrosion

This AMP is not applicable to NMP-1, since it is a BWR. Ginna implements this program through a plant-specific administrative procedure developed to meet the recommendations of Generic Letter (GL) 88-05. This procedure became the Boric Acid Corrosion program (AMP B2.1.16 in the Ginna LRA) and was made consistent with AMP XI.M10 of the GALL Report, Rev. 0, by enhancing it to account for boric acid corrosion of non-reactor coolant system (RCS) components located in areas where there is the potential for boric acid leakage, including cable connections, cable trays, and other susceptible SSCs.

Consistent with the guidance of NRC Regulatory Issue Summary (RIS) 2003-013, the Ginna AMP includes the identification of reactor coolant system locations that contain nickel alloys or welds (e.g., control rod penetrations) for inspection. At Ginna, an initial inspection by a team of pipe fitting and decontamination staff examines relevant surfaces when the system is "as hot as possible," to identify locations of interest. A second team, composed of a VT-2 qualified inspector (with boric acid training per EPRI 1022326) and a trainee or support engineer, later implements follow-up activities later. Ginna personnel stated that they specifically look for rust-colored stains in their visual examinations of boric acid deposits. They also stated that when leakage is identified within the containment or in an area with enclosed ventilation units, the ventilation units are examined for evidence of boric acid deposits. This activity of examining the ventilation units for evidence of boric acid wastage residue is of particular importance in view of the operating experience at the Davis-Besse plant.

The program looks at two characteristics for findings: (1) whether the leak is still active and (2) the volume, color, and location of deposits. The plant personnel stated that they do not restart with active leaks, consistent with the technical specification (TS), and they try to leave no deposits. Their program incorporates a fluid leakage management program for borated systems that looks at leakage severity and considers the risk of locations that have been exposed to leakage. Locations with high and medium risk are generally repaired immediately, whereas low-risk locations may be combined into a single CR for later remediation. Their implementing procedures include provisions for replacement with insusceptible materials. The staff noted that

Ginna continues to find and correct boric acid leakage, with a fairly constant number of CRs identified at each refueling outage.

2.3.11 XI.M11B Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components (PWR only)

This AMP is not applicable to NMP-1, since it is a BWR. The Ginna AMP B2.1.26, "Reactor Vessel Head Penetration Inspection," is focused on managing the effects of crack initiation and growth due to PWSCC of the reactor vessel head and bottom-mounted instrumentation (BMI) penetrations of the Ginna reactor vessel. The program includes performing (a) PWSCC susceptibility assessment to identify susceptible components; (b) monitoring and control of reactor coolant water chemistry to mitigate PWSCC; and (c) ISI of reactor vessel head penetrations and bottom-mounted instrument tube penetrations, in accordance with the ASME Code, Section XI, to detect PWSCC and its effect on the intended function of the component. In 2008, the program also incorporated augmented inspection of ASME Code Case N-729-1 and N-722, which are required by 10 CFR 50.55a. In addition, ASME Code Case N-722-1 and N-770-1 are also being evaluated to be incorporated to the Ginna program. Preventive measures to mitigate PWSCC are in accordance with the Water Chemistry Control program.

In response to the industry-wide operating experience regarding PWSCC in piping butt welds, EPRI issued MRP-139 "Material Reliability Program: Primary System Piping Butt Weld Inspection and Evaluation Guideline," with mandatory implementation for all PWRs under the industry's proactive management of materials degradation initiative, NEI 03-08. The Ginna Alloy 600 Program includes the guidance in MRP-139. However, the licensee's program basis document (PBD) indicated that the additional industry positions on Alloy 600 butt welds contained in the EPRI MRP-139 guidelines have limited applicability to Ginna because the Ginna reactor coolant system was constructed using stainless steel butt welds, which are outside the scope of MRP-139 and not subject to PWSCC. The PBD further indicated that the only Alloy 82/182 butt welds in the reactor coolant system are the BMI Alloy 600 nozzle to safe end welds.

As part of the industry-wide initiative relative to GL 97-01, in 1999, Ginna also performed a comprehensive eddy current inspection of all the Alloy 600 vessel closure head penetrations. The results indicated that no cracking had occurred in these nozzles. As a result of these examinations and industry-wide concerns described in NRC Bulletins 2001-01 and 2002-01, Ginna also replaced the reactor vessel head and CRDM penetrations in 2003. The licensee will continue to follow industry developments related to PWSCC of Alloy 600 through participation in various industry initiatives. The licensee's PBD also indicates that during the 2006 refueling outage, an EPU was implemented with a 17% power increase, and the hot leg temperature was increased during this modification to approximately 321°C (610°F). However, because the replacement reactor vessel closure head uses Alloy 690 CRDM nozzles, they are expected to accommodate the increased temperature associated with the EPU conditions.

2.3.12 XI.M12 Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)

This program manages loss of fracture toughness due to thermal aging embrittlement in CASS components by evaluating the susceptibility to thermal aging embrittlement, based on the casting method, molybdenum content, and percent ferrite. The program also performs flaw tolerance evaluations for the CASS components, which are susceptible to thermal aging embrittlement, to confirm adequate flaw tolerance.

The licensee performed a plant-specific leak-before-break (LBB) analysis for the reactor coolant system piping and the licensee's evaluation confirmed the stability of postulated through-wall flaws in CASS piping components, as discussed in the SER. This LBB analysis is documented in WCAP-15837 and the licensee's plant-specific flaw tolerance analysis for pump casing is described in WCAP-15873. These evaluations conclude that the fracture toughness of the CASS components remains adequate for the PEO (60 years). In addition to these flaw tolerance evaluations consistent with the GALL Report, the licensee credited the ongoing ASME Section XI ISI examinations for managing loss of fracture toughness of CASS piping and piping components. The Ginna plant OpE also indicates that ISI has not revealed any indication on the CASS piping or piping components.

LRA Tables 3.1.1.A and 3.2.1.A and SER Tables 3.1A-1 and 3.2A-1 for NMP-1 indicate that this AMP is not applicable because NMP-1 does not have CASS piping and fittings.

2.3.13 XI.M14 Loose Part Monitoring

At NMP-1, the "Loose Part Monitoring" AMP XI.M14 of the GALL Report, Rev. 0, and Rev. 1, was stated to be not applicable as it was not credited for aging management, and the program was not implemented. Ginna also does not implement the XI.M14 program as an aging management activity, although its LRA describes "Loose Part Monitoring" in Section B2.1.19, which lists 12 AMPs at Ginna that relate to the reactor coolant system and reactor vessel internals. The LRA also notes that there is a loose parts monitoring system employed for the steam generators, called the digital metal impact monitoring system (DMIMS), which is not considered to be an aging management program but rather a reactive measurement system to detect failed or foreign material exclusion (FME) components that have inadvertently entered the steam generators.

During the Ginna audit, the staff noted that the purpose of Ginna's counterpart (B2.1.19) to GALL Report AMP XI.M14 is to rely on inservice monitoring to detect and monitor loose parts in the power plant, in lieu of measures to monitor and detect metallic loose parts with acoustic signal data analysis, as intended in the GALL Report, Rev. 0. This revision of the GALL Report, in the Chapter 4 AMR line items (reactor vessel, internals, and RCS) using AMP XI.M14, always coupled it with GALL Report AMP XI.M1 to manage the loss of preload due to stress relaxation. The GALL Report, Rev. 1, did not apply AMP XI.M14 to any AMR line items. However, based on acceptable plant-specific experience, as noted by Ginna in response to an earlier LRA request for additional information (RAI) 2.2.2-4 (May 13, 2003), and the use of AMP XI.M1 to manage loss of preload due to stress relaxation, the staff agreed in the license renewal SER that loose parts monitoring did not appear necessary. The staff's SER and subsequent inspection/audit reports did not evaluate this program for license renewal, since it was not credited for any AMR items for SSCs within the scope at Ginna.

Also, during Ginna audit, the staff's search of the ePIC (Electronic Performance Improvement Center) database, looking at CR and corrective action program (CAP) records for any significant incidence of loose parts in the primary coolant system and the reactor vessel internals, found only that there were various cases of high false alarm rates, over-sensitivity, and limited capability for interpreting alarms and signals. The records indicated that there has been work to improve the signal to noise ratio (EPRI NP-5743).

2.3.14 XI.M15 Neutron Noise Monitoring

This AMP is not applicable to NMP-1 since it is a BWR. The program monitors the excess neutron detector signals due to core motion to detect and monitor significant loss of axial preload at the core support barrel's upper support flange in PWRs. Ginna does not have a separate aging management program corresponding to AMP XI.M15 of the GALL Report, Rev. 0. Instead, Section B2.1.20 of the LRA notes that the changes in reactor vessel internal support structures (such as the core support barrel's upper support flange) are managed by its other AMPs, namely, the "ASME Section XI, Subsections IWB, IWC, IWD, Inservice Inspection" (LRA Section B2.1.2) and the "Reactor Vessel Internals" (LRA Section B2.1.27).

During the Ginna audit, the staff noted that the GALL Report, Rev. 0, had only two Chapter IV AMR line items (reactor vessel, internals, and RCS) that invoked AMP XI.M15, both of which were coupled with AMP XI.M1 and AMP XI.M14 to manage the loss of preload. The staff further noted that in GALL Report, Rev. 1, AMP XI.M15 was not used for any AMR line items, and in NUREG-1950 (the basis document for the GALL Report, Rev. 2), AMP XI.M15 was eliminated due to lack of relevance and very limited previous usage in submitted LRAs. During the audit at Ginna, the staff searched the licensee's ePIC database containing CR/CAP records to verify if any increase in clearances and wear of mating surfaces at the barrel upper support area were observed in related inspections or OpE. Of interest was how these observations were evaluated in relation to the loss of axial preload consideration, and in relation to the alternate two AMPs that B2.1.20 references. The Ginna staff stressed that the ISI program examined head bolting and hold-down springs, and that the leakage monitoring detected any leakage into the space between the related O-rings. Any increase in clearances and wear of mating surfaces at the barrel upper support area (between inspections) are assumed to be small enough to have little impact on the loss of preload and/or axial restraint, and to have been rectified if necessary during the next outage.

2.3.15 XI.M16A PWR Vessel Internals

This AMP is not applicable to NMP-1 because it is a BWR. The Reactor Vessel Internals (RVI) program approved for Ginna in the SER was a plant-specific version of the AMP in the GALL Report, Rev. 0. The LRA stated that Ginna would monitor ongoing industry initiatives and committed to modify its program "appropriately to incorporate industry lessons learned." The program as identified in the LRA is based on augmentation of the ASME Section XI ISI Program for certain susceptible or limiting components or locations. One aspect of the program cited in the LRA was augmentation to enable detection of fine cracks in non-bolted components with enhanced visual examination methods capable of resolving 0.0005-in. features of interest.

During the Ginna audit, the licensee stated that it had implemented the initial inspection under its program consistent with Materials Reliability Program (MRP) MRP-227, Rev. 0, and will update its program through a comparison with MRP-227-A to determine the path forward to achieve consistency with MRP-227-A. During the Ginna audit, the licensee stated that it may require deviations which it will justify through the MRP-227-A process. This AMP is unusual in that it is dependent on industry development of, and NRC approval of, a topical report to guide the development of inspection plans by PWR plants. As described above, the examinations that have been implemented by Ginna are not necessarily reflective of those that it will implement to achieve consistency with MRP-227-A during the PEO.

The PWR Vessel Internals program uses a combination of visual and ultrasonic examination methods to detect discontinuities and imperfections (such as loss of integrity at bolted or welded connections, loose or missing part, debris, corrosion, wear, or erosion) and verify parameters (such as clearances, settings, and physical displacements). One exception was cited in the LRA and the SER, which anticipated that some augmented examinations specified in the industry-recommended program might be performed only once, in contrast to the ISI Program frequency of 10 years. Since the applicant identified that its required inspections and frequency of inspection would depend on the results of the industry program on the PWR Vessel Internals program, the only significant RAI was a commitment by the applicant to ultimately submit its

PWR Vessel Internals program for NRC review and approval prior to entering the PEO. The applicant ultimately did submit its program for NRC review and approval; NRC review was delayed pending acceptability of the industry program, as embodied in the MRP-227 report. With the issuance of MRP-227-A and consistent with the guidance of RIS 2011-07, Ginna stated that it will withdraw its RVI program submitted for NRC review and approval and re-submit it within 1 year consistent with MRP-227-A (note, the new submittal is dated September 28, 2012).

The Ginna PWR Vessel Internals program inspections included significant interactions with a U.S. Department of Energy (DOE) program that is addressing plant long-term operation. Therefore, the results of the inspections will be provided in various reports and papers. In addition, findings from the inspections will be documented through the MRP process to all PWR licensees, and the inspections modified accordingly. The applicant specifically discussed the following examinations (including some background):

- Baffle-to-former bolts
  - With the D.C. Cook plant finding baffle bolt heads at the bottom of its reactor pressure vessel (lower core support plate), additional criteria were added at Ginna to visually examine the bolt head welds (locking device) as a first step.
  - Surry operating experience of ~1-2 UT indications out of 1,080 bolts inspected.
  - The Beznau (a Swiss plant of similar design and age) found unsatisfactory UT results in 2009.
  - In 1999, Ginna replaced 56 out of 728 bolts after UTs of the 639 accessible bolts. Although 14 bolts were identified as having indications, laboratory examination of the 54 removed bolts that didn't fail upon removal identified only one with a crack, indicating that the ultrasonic test method employed at that time was conservative.
  - In 2011, Ginna's target was to demonstrate a minimum bolting pattern of 121 bolts plus a 50 percent margin which would justify operation for 10 years, with an assumption that 50 percent of the 728 bolts failed.
  - Observations from the inspections:
    - Bolt removal productivity rate was much slower than anticipated (18 bolts per day were scheduled and only 4-5 per day were actually being removed).
    - In the higher fluence region, there were issues with putting bolts back in; left three open holes at the end of the outage.
    - Some fuel impingement and structural impact from water-jetting (also called baffle-jetting).
    - 28 bolts removed; UT performed from the back side (non-shank end) on 24 bolts that were undamaged by removal, and identified no issues; 25 new bolts installed.
    - UT performed on the 56 bolts installed in 1999 and 99 original bolts and found only one indication in an original bolt.
    - Current plant-specific acceptance analyses by AREVA and Westinghouse in conjunction with 1999 and 2011 inspection results for current condition justify acceptable operation until the next MRP-227 inspection in 10 years.
- No indications from the following additional vessel internals visual inspections:
  - VT-3 of core barrel circumferential welds from inside diameter and some from the outside diameter

- VT-3 of clevis pin insert screws (D.C. Cook found cracking)
- EVT-1 of lower flange weld of guide tubes
- VT-3 of guide cards
- VT-3 of flexures
- EVT-1 of upper core barrel to flange weld from inside diameter (ID) and outside diameter (OD)
- VT-3 of baffle plate seams
- VT-3 of edge bolts

As discussed above, additional changes are being made to make this program consistent with MRP-227-A.

2.3.16 XI.M17 Flow-Accelerated Corrosion

Ginna implements this program through its AMP B2.1.15, “Flow-Accelerated Corrosion” and NMP-1 through its AMP B2.1.9, “Flow-Accelerated Corrosion Program.” The AMPs at Ginna and NMP-1 are based on Revision 0 of the GALL Report, and both LRAs state that the respective AMPs are consistent with AMP XI.M17 of the GALL Report, “Flow-Accelerated Corrosion,” with no exceptions or enhancements. Both LRAs note that their AMPs are in accordance with EPRI guidelines in the Nuclear Safety Analysis Center (NSAC) NSAC-202L, Rev. 2, and both utilize the CHECWORKS predictive code.

During the Ginna audit, the site personnel noted that the PBD was revised showing that the service water piping and the fire protection piping were removed from its flow-accelerated corrosion (FAC) program scope and the CHECWORKS model was converted and updated to SFA Version 2.1. The staff found that Ginna’s most recent program health report provided an excellent picture of the program’s implementation and the status of current issues, and that the program appeared to address other wall thinning mechanisms like cavitation, even though these mechanisms do not meet the definition of flow-accelerated corrosion. (Subsequent to the audits at Ginna and NMP-1, NRC staff issued a draft license renewal Interim Staff Guidance (LR-ISG) to expand the scope of GALL AMP XI.M17 to also address cavitation and other erosion phenomena.) In addition, the staff noted that the site upgraded to NSAC-202L, Rev. 3, which is consistent with the GALL Report, Rev. 2.

During the NMP-1 audit, the site’s most recent program health report (third quarter 2011) provided a comprehensive picture of the program’s implementation and related issues. The staff noted that the FAC program inspection scope did not need to be expanded during the last outage from the initial plan and that the FAC-related repairs or replacements had been anticipated based on prior inspection results. From an OpE perspective, the program health report also maintained a list of relatively recent plant-specific and industry issues along with the disposition for each item. This provided documentation that operating experience was being considered and evaluated as part of the AMP at NMP-1.

2.3.17 XI.M18 Bolting Integrity

Ginna implements this program through its AMP B2.1.5, “Bolting Integrity,” and NMP-1 through its AMP B2.1.36, “Bolting Integrity Program,” both of which are based on the GALL Report, Rev. 0. The NMP-1 LRA states that its program will be consistent with the GALL Report, after completing enhancements, as stated in Commitment No. 33 in Appendix A of its LRA, prior to entering the PEO. The NMP-1 LRA notes that its bolting integrity program is implemented through the ASME Section XI ISI Programs (subsections IWB, IWC, IWD, IWE, IWF), the Structures Monitoring Program, the Preventive Maintenance Program, and the Systems Walkdown Program. The Ginna LRA states that the Bolting Integrity program is consistent with the GALL Report, with no exceptions, enhancements, or commitments, and that it credits activities performed under the direction of other aging management programs for managing specific aging effects.

The Ginna audit confirmed that its Bolting Integrity program, although cited as a separate program, does not implement any activities itself, but instead credits activities performed under several other AMPs for managing specific aging effects associated with bolting. During the Ginna audit, the staff noted that the applicant's PBD identified that one of these credited AMPs, namely, its Structures Monitoring program, was not consistent with the GALL Report AMP in that additional tests for detecting degradation of structural bolting and fasteners, such as hammer tests, in-situ ultrasonic tests or proof tests by tension or torqueing were not planned unless specifically required as a result of a potentially degraded condition. The implementation of this Ginna AMP was not evaluated because all inspection activities are conducted through the implementation of other AMPs. The Ginna audit found no condition reports specifically connected with its Bolting Integrity program, so no corrective actions could be evaluated relative to this program. Also, the Ginna operating experience review reports consistently stated that either no inspections were performed or no conditions were noted. During the Ginna audit, it was noted that the PBD was revised in April 2009.

The NMP-1 auditor noted that NRC inspectors reviewed the commitments associated with this program, during its IP 71003, "Post-Approval Site Inspection for License Renewal," and concluded that the licensee had enhanced the Bolting Integrity, Structures Monitoring, and System Walkdown Programs as stipulated in Commitment No. 33 (NRC Inspection Report 05000220/2009007). The NMP-1 audit also noted that, although the program was not included in any recent program health report, the licensee's recent self-assessment concluded that there were no issues with the AMP. This report also stated that the licensee had identified and inspected all high-strength bolting and had included any condition monitoring requirements for the remaining bolting in the Structures Monitoring and Systems Walkdown inspection checklists.

2.3.18 XI.M19 Steam Generators

This AMP is not applicable to NMP-1 because it is a BWR. The Ginna LRA states that Ginna implemented this program through its AMP B2.1.31, "Steam Generator Tube Integrity," which is based on the guidance documents NEI 97-06 and EPRI TR-107569. The Ginna AMP is consistent with AMP XI.M19 of the GALL Report, "Steam Generator Tube Integrity," as described in the SER for Ginna license renewal.

In view of the recent industry OpE on the PWSCC of nickel-based alloys in the steam generator (SG) divider plate assemblies and tube-to-tubesheet welds, the staff requested the licensee to provide information regarding its actions in addressing the aging management of these SG components. In its review, the staff noted that the licensee uses PWSCC-resistant Alloy 690 tubing with the tube sheet cladding made of Alloy 82. A potential concern is that the autogenous welds of the tubes with Alloy 82 cladding may cause dilution effects on material composition so that the resistance of the welds to PWSCC may be decreased.

It was also noted that qualified eddy current techniques for the tube-to-tubesheet welds have not been developed yet. In addition, Ginna indicated that it performed 100 percent visual inspections of the divider plate weld areas during the last two SG inspections (2008 and 2011), with no detectable degradation.

During the Ginna audit, the staff also noted that the licensee's Technical Specifications (TS) require maintaining a SG Tube Integrity program that is consistent with the industry guidance NEI 97-06, which is the basis for the SG AMP. The staff further noted that the Ginna AMP is based on the latest industry examination guidelines (EPRI 1013706, *PWR Steam Generator Examination Guidelines: Revision 7).*

As part of the audit of the SG AMP implementation at Ginna, the staff reviewed the licensee's performance concerning the potential for degradation due to foreign objects and noted that the GALL Report, Rev. 2, addresses FME. The licensee indicated that it has implemented a Foreign Object Search and Removal (FOSAR) Program in SG vendor procedures and that its OpE indicates foreign object exclusion to be a potential concern related to the material degradation in SG components.

In addition, the staff noted that the licensee's program health report and report on "license renewal related condition report trends" periodically assess the OpE related to the Steam Generator Tube Integrity program and associated components.

2.3.19 XI.M20 Open Cycle Cooling Water System

This program is implemented at Ginna through its AMP B2.1.22, "Open-Cycle Cooling (Service Water) System." The Ginna AMP lists the following two exceptions to AMP XI.M20 of the GALL Report, Rev. 0,: (1) heat transfer tests are not performed on selected small heat exchangers that are periodically cleaned and inspected in accordance with Ginna AMP B2.1.23, "Periodic Surveillance and Preventive Maintenance," and (2) the Ginna AMP does not address protective coatings, which are not credited for aging management in the Ginna service water system. The PBD was updated in April 2009, by adding specific references to the license renewal service water system program plan and requiring completion of a generic service water system inspection checklist. Both Ginna AMP B2.1.22, Service Water System Reliability and Optimization, and the amended NMP-1 AMP B2.1.10, Open Cycle Cooling Water System Program, cite the guidance given in NRC GL 89-13 and 10 CFR Part 50, Appendix B, which is also included in the GALL Report, Rev. 2.

It was noted during the Ginna audit that increased roughness was observed on the inner surfaces of open-cycle cooling water (OCCW) system piping due to the formation of tubercles and other ongoing fouling mechanisms. This aging mechanism impacted the piping internal roughness assumptions used in developing acceptance criteria for the safety-related supply in the auxiliary feedwater system. Specifically, due to the increased roughness from this aging mechanism, the Ginna staff noted that the current acceptance criteria established for pressure requirements may not provide sufficient flow through the affected piping in the event of a loss of coolant accident (LOCA). Since this configuration is not tested due to the adverse effects of introducing raw water into the SGs, additional steps may need to be taken to address this aspect.

As stated above, Ginna took an exception to GALL Report guidance that calls for heat transfer tests on selected small heat exchangers in the OCCW system; instead, its program relies on periodic cleaning and inspection.

NMP-1 implements this program through its AMP B2.1.10, "Open Cycle Cooling Water System Program." The NMP-1 AMP identifies no exceptions, but it lists the following enhancements: (a) ensure that the applicable NMP-1 commitments made for GL 89-13, and the requirements in the GALL Report, Section XI.M20, are captured in the appropriate NMP-1 documents; (b) where the requirements of GALL Report XI.M20 are more conservative than the GL 89-13 commitments, they will be incorporated into the NMP-1 AMP; and (c) revise the NMP-1 preventive maintenance and heat transfer performance test procedures to incorporate specific inspection criteria and frequencies, and corrective actions. Revision 1 of the PBD was issued November 10, 2009, which discussed problems with the eddy current inspections of the containment spray cooling heat exchangers due to manufacturing variations. The document noted that these variations made the heat exchangers un-inspectable with conventional eddy current technique and stated that pressure tests from the shell side verified no tube leakage. Other changes to some of the implementing procedures were noted, but these did not appear to be the result of specific problems with the program or the result of enhancements due to aging-related operating experience.

The July–September 2011 System Health Report for the service water system at NMP-1 noted that heat exchanger performance was very good, but discussed the condition of the emergency service water piping condition and the need to replace 14-in. diameter discharge piping because of wall thinning. It also noted that much of the small-bore piping is in “a generally degraded condition.” As a result, through-wall leaks occur at an “unacceptable” frequency of approximately one per year for 3-in. and smaller diameter piping. Furthermore, the frequency of leaks is increasing. The report also stated that the current practice at NMP-1 is to repair service water piping leaks when they occur. The licensee subsequently stated that funding has been approved to replace all 3-in or less diameter piping from 2015 through 2020. The 14-in. diameter emergency service water discharge piping is also funded for replacement over the next two RFOs in 2013 and 2015.

2.3.20 XI.M21A Closed Treated Water System

This program is implemented at Ginna through its AMP B2.1.9, “Closed-Cycle (Component) Cooling Water System.” However, Ginna takes an exception to AMP XI.M21 of the GALL Report, Rev. 0, in that EPRI TR-107396 is not referenced in Ginna procedures, and the only parameters monitored are pH, corrosion inhibitor concentrations, and radioactivity. NMP-1 implements this program through its AMP B2.1.11, “Closed-Cycle Cooling Water System Program.” The NMP-1 program takes no exceptions to AMP XI.M21 of the GALL Report, Rev. 0, but adds a number of enhancements to make it consistent with the GALL Report. These enhancements include (1) expanding periodic chemistry checks of closed-cycle cooling water (CCCW) systems consistent with the guidelines of EPRI TR-107396; (2) implementing a program to use corrosion inhibitors in accordance with the guidelines given in EPRI TR-107396; (3) performing periodic inspections to monitor for loss of material in the piping of the CCCW systems; (4) implementing a corrosion monitoring program for larger bore CCCW piping not subject to inspection; (5) establishing inspection frequencies for degradation of components in CCCW systems; (6) performing a heat removal capability test for the NMP-1 control room heating, ventilation, and air conditioning (HVAC) system at least every 5 years; (7) establishing periodic monitoring, trending, and evaluation of performance parameters for several CCCW systems; (8) providing the controls and sampling necessary to maintain water chemistry parameters in CCCW systems within the guidelines of EPRI Report TR-107396; and (9) ensuring acceptance criteria are specified in the implementing procedures for the applicable indications of degradation.

A review of the condition reports for Ginna did not indicate any significant degradation problems in the CCCW system.

It was noted during the NMP-1 audit that the licensee had modified its commitment regarding the implementation of corrosion inhibitors, in accordance with EPRI guidelines, in the reactor building closed cooling and control room HVAC systems prior to the PEO. The commitment was changed, through the prescribed change process, to maintain a pure water system chemistry (i.e., corrosion control is managed by restricting oxygen, with no corrosion inhibitors or chemical additions to demineralized water), in accordance with EPRI guidelines.

The NMP-1 LRA and SER allude to “various forms of degradation” that have occurred in the CCCW system and state that these problems were addressed by increased monitoring, component repair, or component replacement. However, no details on the relevant specific OpE events or the remedial actions were given. A review of the NMP-1 PBD for the CCCW system during the present audit provided those details, including numerous incidents of pipe leaks in the reactor building closed-loop portion of the system that required significant system makeup over time. These included seven incidents of pipe wall thinning from 1996 to 2003 and 10 occurrences of leakage at threaded and mechanical joints from 2001 to 2003. These failures were attributed to a combination of general, galvanic, and flow-accelerated corrosion as well as inadequate design of threaded joints and inadequate wall thickness. There have also been problems over the years with maintaining nitrogen overpressure in the system surge tank. These problems appear to have resulted in higher levels of dissolved oxygen than specified in the CCCW chemistry and consequent corrosion problems. The problems were addressed by replacing the reactor building closed-loop system piping with schedule 80 pipe rather than the original schedule 40 pipe and by the installation of an oxygen removal skid. The absence of similar events after the implementation of these remedial actions indicates that they have adequately addressed these problems.

The NMP-1 Program Health Report and System Health Report include the results of periodic assessments of the implementation of the NMP CCCW system program, a list of any degradation observed, and a summary of the overall status of the system. The most recent report stated that the AMP is working well, but because of finding degradation in system components, applicable preventive maintenance frequencies have been increased from every third cycle to every cycle.

2.3.21 XI.M22 Boraflex Monitoring

Ginna incorporates Boraflex neutron absorber panels in its spent fuel pool (SFP). However, reliance on the neutron absorption capability of the Boraflex panels was discontinued when the NRC approved License Amendment 79 on December 7, 2000. That amendment provided for reliance on soluble boron instead of the Boraflex. Therefore, Ginna has no AMP corresponding to GALL Report AMP XI.M22. Ginna also relies on borated stainless steel for neutron absorption, and aging of this material is managed by its AMP B2.1.30, “Spent Fuel Pool Neutron Absorber Monitoring,” which is similar in scope to AMP XI.M40 of the GALL Report, Rev. 2, “Monitoring of Neutron-Absorbing Materials Other Than Boraflex.” This Ginna AMP is discussed in Section 2.3.37 of this report.

NMP-1 implements this program through its existing AMP B2.1.12, “Boraflex Monitoring Program.” Program activities include (1) visual inspection of test coupons to detect gap formation; (2) correlation of measured levels of silica in the SFP with analysis using a predictive code (e.g., RACKLIFE) to estimate boron loss from Boraflex panels; (3) neutron attenuation testing to measure the boron areal density (by the BADGER device) of the short-length test coupons; and in-situ neutron attenuation testing of the Boraflex storage racks. The Boraflex Monitoring Program is based on existing technology and methods for testing and evaluating material properties necessary to ensure the required 5% margin to criticality in the SFP is maintained.

With enhancements, the AMP is consistent with the recommendations of AMP XI.M22 of the GALL Report, Rev. 0, “Boraflex Monitoring.” The enhancements to the NMP-1 program include performing periodic in-situ neutron attenuation testing, which serves to measure boron areal density to confirm the correlation of the conditions of the test coupons to the conditions of the Boraflex racks that remain in use during the PEO. In addition, the program includes monitoring and trending requirements for in-situ test results, silica level, and coupon surveillance test results.

The program manages aging of Boraflex degradation by conducting coupon surveillance testing, performing in-situ neutron attenuation testing and monitoring silica concentration in the SFP. The licensee reported that the correlation between the surveillance test coupons and neutron attenuation testing yielded a close relationship of <1% difference. NRC staff does not agree with comparing the BADGER results to the coupon test results, based on guidance in AMP XI.M22 in GALL Report, Rev. 2, that the results of the coupon test may not be reliable.

The NMP-1 SFP originally had eight Boraflex racks, but only two of these racks remain. Two re-rack campaigns were performed in 1999 and 2004, which replaced most of the original Boraflex and the remaining original equipment non-poison racks with Boral racks.

The silica concentration in the NMP-1 SFP is monitored on a monthly basis for trending. Unpredicted excursion in the rate of increase in silica levels was not observed in this audit.

2.3.22 XI.M23 Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems

Ginna implements this program through its AMP B2.1.18, "Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems," and NMP-1 through its existing AMP B2.1.13, "Inspection of Overhead Heavy Load and Light Load Handling Systems Program." The AMPs implemented by both Ginna and NMP-1 are consistent with AMP XI.M23 of the GALL Report, Rev. 0. NMP-1 had the following commitment in Appendix A of the SER prior to the PEO: "Revise applicable procedures related to the Crane Inspection Program to add specific direction for the performance of corrosion inspections, with acceptance criteria, for certain hoist lifting assembly components."

The AMP at Ginna is mainly a visual and external surface monitoring program to detect corrosion or wear of equipment that is primarily used during refueling outages to lift spent fuel from the SFP. The components in the scope of the program are passive components including bridge, trolley, rails, stops, and lifting devices. The remaining parts of the crane have been screened out as being active and subject to replacement based on qualified life. All cranes are inspected annually, except for cranes in containment, which are inspected on 18-month cycles during outages. The results for the inspections are included in work orders in the MHE-201 procedure for managing corrosion prior to entering the PEO. For the 2011 refueling outage during PEO, the inspection results are in the MHE-201 procedure and on the license renewal aging management check lists.

During the audit, the licensee stated that the cranes at Ginna are indoors and that no corrosion has ever been found during inspections. One crane failure has occurred at Ginna and that was during original construction. This failure was due to human error and was not aging related. Most cranes are visually accessible for inspection. The inspection frequency is consistent with the GALL Report.

The program at NMP-1 includes: (a) performance of various maintenance activities on a specified frequency; and (b) pre-operational inspections of equipment prior to lifting activities. The program is consistent with AMP XI.M23 of the GALL Report, Rev. 0, after incorporating an enhancement requiring pre-lift corrosion inspections of certain hoist lifting assembly components. The audit did not find any major issues and no new aging effect was identified for SLR.

2.3.23 XI.M24 Compressed Air Monitoring

Ginna states in its LRA that the air-operated valves in the plant were verified to be fail-safe on loss of air, that the compressed air systems at Ginna did not perform a safety function, and therefore the Ginna air systems are not within the scope of license renewal. During this audit, the licensee stated that aging effects on components within the system were managed through the site's AMP B2.1.33, "System Monitoring."

A self-assessment of the instrument air system was performed in 2010, which evaluated the adequacy of the current program with recommendations 4 and 5 given in SOER 88-1, "Instrument Air System Failures." The licensee identified eight improvements during its assessment to strengthen the program. In addition, condition reports including receiver tank wall thickness measurements indicated that the program was adequately identifying issues. An independent review of Ginna OpE did not indicate any significant problems in the compressed air system.

NMP-1 implements this program through its AMP B2.1.14, "Compressed Air Monitoring Program." NMP-1 made specific exceptions to any maintenance recommended in EPRI TR-108147 that is not also endorsed by the equipment manufacturers, and to the preservice and guidelines of ASME OM-S/G-1998, Part 17. NMP-1 also added the following enhancements: (a) develop new activities to manage the loss of material and SCC and perform periodic system leak checks; (b) expand the scope, periodicity, and inspection techniques to ensure that the aging of certain sub-components of the dryers and compressors are managed; (c) develop and implement activities to address the failure mechanism of SCC in unannealed red brass piping; (d) establish activities that manage the aging of the internal surfaces of carbon steel (CS) piping and that require system leak checks to detect deterioration of the pressure boundaries; and (e) expand the acceptance criteria to ensure that the aging of certain subcomponents of the dryers and compressors are managed.

At NMP-1, comprehensive visual walkdown inspections of the compressed air system components are performed at 2-year intervals, based on the plant's refueling cycle, and monthly walkdowns of selected components accessible during plant operation. Instrument air sampling components are inspected at either 3- or 6-month intervals. Internal and external cracking of red brass components in the system has been a problem in the past, and all of the red brass components in the system have since been replaced. No other significant component replacements have taken place.

2.3.24 XI.M25 BWR Reactor Water Cleanup System

This AMP is not applicable to the Ginna because it is a PWR. The BWR Reactor Water Cleanup (RWCU) System Program of NMP-1 (B2.1.15) manages the effects of SCC and IGSCC to maintain the intended function of austenitic stainless steel piping in the RWCU system. This program is based on the NRC criteria related to the inspection guidelines for RWCU system piping welds outboard of the containment isolation valve as delineated in NUREG-0313, Rev. 2, and GL 88-01. The program performs volumetric examinations on the welds included in the scope of the program. The licensee's fourth interval ISI program indicates that two IGSCC Category E welds located outboard of the primary containment isolation valves are included in the inspections. The licensee also implemented the guidance of BWRVIP-75-A to the augmented inspection program per GL 88-01. This is consistent with the GALL Report.

No significant change in procedures was identified in the staff's review of the onsite documentation and interview with the licensee.

The licensee's fourth 10-year interval ISI plan indicated that two non-safety, non-Code-class welds in the reactor water cleanup system experienced through-wall leakage. The inspection plan further indicated that these welds are located outboard of the primary containment isolation valves. In addition, SER Section 4.7.5.1 indicates that the leakage was due to IGSCC. The two non-safety welds were repaired using weld overlays (SER Section 4.7.5.1) and assigned to Category E. This classification is considered to provide reasonable assurance to manage the aging effect of the RWCU system outboard welds. The fourth interval inspection plan also indicated one weld out of the two welds was inspected within the first 6 years of the interval. The licensee indicated that no separate health report is generated for this program. However, the health report for the ASME ISI program includes the inspection activities for the welds included in the program scope of this AMP.

2.3.25 XI.M26 Fire Protection

Ginna implements this program through its AMP B2.1.13, "Fire Protection." As stated in the Ginna LRA and SER, the Fire Protection (FP) AMP manages aging effects (loss of materials, increased hardness and shrinkage, cracking and spalling of steel, elastomeric, and concrete materials) on the intended function of the penetration seals, fire barrier walls, ceilings, and floors, and all fire-rated (automatic or manual) doors that perform a fire barrier function.

At Ginna, previous fire barrier inspection results, action reports, and maintenance work requests showed that fire seals, barriers, and walls remain intact to perform their intended function. Inspections have identified event-driven degradation such as torn Hymec wrap, damaged fire seals, and cracked mortar/caulk in walls; no evidence of age-related degradation has been detected. Trending reports and system health reports for the Ginna FP AMP are prepared on a quarterly basis. Trending reports were analyzed during the audit; it does not appear that there are a significant number of condition reports since 2008. Only three were related to the FP program, and they were all at a low category of concern.

The Ginna FP AMP includes aging management of fire breaks, fire wraps, and grout. These items are passive components that are not included in the GALL Report. A fire break is a passive fire protection feature of construction intended to limit flame propagation along vertical or horizontal cable tray runs. The fire wrap is a passive fire and/or heat resistant covering (e.g., Hymec wrap) used to protect or shield safe shutdown circuits. Aging effects and aging mechanisms of fire break and fire wrap are identified in the Ginna AMP. Visual inspections of fire doors and verification of clearances are performed on a quarterly basis, and not bimonthly as stated in the GALL Report. A review of Ginna quarterly fire door walkdown operating experience indicated that these issues have not been of concern.

During the AMP audit interview, Ginna FP AMP program owners confirmed that Ginna is continuing to test the diesel-driven fire pumps. The Ginna FP AMP states, "Periodic testing of the motor and diesel-driven fire pumps ensures that adequate flow of fire water is supplied and that there is no degradation of diesel fuel lines to the diesel fire pump," and, "Two redundant, full capacity fire pumps, one electric-motor driven and one diesel driven, with independent power supplies and controls are provided. The fuel supply tank for the diesel driven fire pump contains an eight hour minimum fuel supply."

The Ginna FP AMP standard test procedure (STP) -O-13 states, "Performance test is performed monthly to verify the standby operability of the diesel engine-driven and electric motor-driven fire pumps." It also states, "Periodic testing of the fire pumps provided data and trending to justify replacement of diesel fire pump engine in 1994 and replacement of both pump assemblies in 2002 and 2003 to address wear-related impeller and column pipe issue." During the audit, it was reported that impeller wear of the electric motor-driven fire pump has been observed at Ginna.

Additional equipment was added to the list of safe-shutdown components to account for the effects of increased decay heat due to the Ginna power uprate. Ginna stated that there was no impact of EPU on the FP AMP, and the program will continue to meet the requirements of 10 CFR 50.48, Appendix R to 10 CFR Part 50, and general design criteria (GDCs) 3 and 5 following implementation of the EPU.

The reactor coolant pump (RCP) oil collection tank was also discussed during the audit, and no issue was noted. Overall, no major concerns were identified in Ginna's FP AMP during the audit. The AMP has numerous detailed plant inspection and testing procedures in place.

NMP-1 implements AMP XI.M26, "Fire Protection," through its existing AMP B2.1.16, "Fire Protection Program." The NMP-1 FP AMP is consistent with GALL Report XI.M26 with exceptions and enhancements. The AMP takes exceptions to the aspects of the AMP in the GALL Report, Rev. 0, that relate to bimonthly inspections of hollow metal fire doors (Element 3) and monthly inspection of the Halon/carbon dioxide suppression system valve lineup (Element 4). These requirements have been revised in later versions of NUREG-1801. The enhancements to the AMP are as follows: (a) incorporate periodic visual inspections of piping and fittings in a non-water environment such as Halon and CO_2; (b) expand the scope of periodic functional tests of the diesel-driven fire pump to include inspection of engine exhaust system components for corrosion; and (c) perform an engineering evaluation to determine the plant-specific inspection periodicity of fire doors. During inspection of corrosion of the fire pump exhaust system, a borescope was sent down into the exhaust pipe to verify that corrosion has not occurred.

The NMP-1 FP AMP owners pointed out that some fire barrier penetration seals (i.e., silicone foam, elastomer, Kaowool, and flamastic) were damaged. Flamastic sealant, when subjected to vibration and thermal cycling, can become brittle and after heating can swell and crack. Routine inspection of these penetrations has been performed adequately to ensure that defects are repaired prior to loss of functionality.

In the July–September 2011 "Fire Detection and Fire Suppression System Health Report," NMP-1 determined that performance of fire protection and fire water systems was unacceptable in this period. The report stated that critical issues include:

- Degradation of CO_2 system
- Poor reliability of fire panels, detection systems, and Drazetz recorder
- Diesel fire pump (DFP) piston ring wear margins issues
- Smoke removal dampers with failure rates due to binding; NMP-1 stated that dampers are a Safe Air Model 700 that are obsolete and have a history of repetitive failures (bindings); NMP-1 plans to upgrade the dampers to a new design

NMP-1 pointed out that aging and obsolescence are issues for the fire panels, and the dampers failing to stroke was most likely caused by age-related degradation of the damper actuators. All of the dampers are early 1980 vintage equipment. In CR-2005-001483, smoke removal dampers were observed to not open under any circumstances.

The licensee later provided the following clarifying insight into the four items listed above. In the licensee's view, none of these issues identified in the System Health Report are related to aging management of components within scope of LR. The CO_2 system issue is specific to operations issues relative to personnel safety upon actuation; the 2nd issue is specific to instrumentation (active) anomalies for panels that are scheduled to be replaced; the 3rd is specific to the diesel engine (active) which was replaced in 2011; and the 4th is specific to dampers (active). It is also noted that the fire panels and dampers are active components and not within scope of LR.

Based on review of inspection procedures and discussion with the AMP program owner during the audit, the AMP was found to be demonstrating adequate performance in monitoring loss of material and cracking via visual inspection and testing of penetration seals, fire barrier walls, ceilings and floors, cable coatings and fire-rated doors to verify that these components continue to perform their intended functions. Visual inspections of fire barriers and penetrations, which include all sealing devices, are documented. Aging effects associated with flamastic sealants, detectors, and damper actuators were observed and documented.

2.3.26 XI.M27 Fire Water System

Ginna implements this program through its AMP B2.1.14 "Fire Water System." This AMP manages aging effects including loss of material due to general, pitting, crevice, and galvanic corrosion, microbiologically-influenced corrosion (MIC), and biofouling within the fire water system (FWS) and associated components (sprinklers, nozzles, fittings, hydrants, hose stations, standpipes, fire water storage tank, fire booster pump, etc.). The Ginna LRA AMP contains the following exceptions to the GALL Report, Rev. 0: (a) the GALL Report states that sprinkler systems are to be inspected once every refueling outage, whereas sprinkler system headers and spray heads are inspected every 2 years at Ginna; (b) the GALL Report states that fire hydrant flow tests are to be performed annually, whereas, fire hydrants are flushed annually at Ginna by opening each hydrant fully and verifying (qualitatively) adequate flow. Flow test and performance trending data are collected every 3 years, and the frequency is supported by plant-specific OpE (DA-ME-97-081) and industry practice. In Appendix A of the Ginna SER (NUREG-1786), one of the Ginna commitments was to implement the following items during the PEO, or within a few years:

- Replace or test a representative sample of FWS sprinklers that have been in service for up to 50 years.
- Define selection criteria, sample size, and periodicity of inspections for fire system piping.
- Add fire service water (SW) booster pump and associated valves and piping back to the service water system into the scope of the license renewal.

Ginna performs 3-year inspections on fire water storage tanks. During the 2004 inspection, 32 areas of coating failures were found in the interior of the fire storage water tank. There are 16 FWS-related CRs from 2008 to 2010 in the trending documents. Most of the CRs relate to excessive corrosion on fire piping, valves, vent, drain, and bolts, and selective leaching of valves. The corrective actions for CR-2009-003214 included adding inspection results to the FWS corrosion-monitoring program for tracking periodic fire water piping inspections.

The Ginna FWS AMP includes the management of aging effects in buried cast iron piping and fittings. External surfaces of buried piping are visually examined during maintenance activities (opportunistic inspection) conducted during performance tests. No age-related degradation has been detected from these inspections performed to date.

Generally, aging effects were found by this AMP and were documented in the CRs.

NMP-1 implements this program through its existing AMP B2.1.17, “Fire Water System Program.” The program activities include periodic maintenance, testing, and inspection of system piping and components containing water (e.g., sprinklers, nozzles, fittings, valves, hydrants, hose stations, standpipes) in accordance with National Fire Protection Association (NFPA) codes and standards. Since Lake Ontario is the source of water, water storage tanks are not in the scope of the AMP. Site procedure S-CTP-V632, “Sampling and Analysis of Water Systems for Bacteria,” is credited with managing loss of material due to MIC by sampling and analysis of raw water systems for the presence of bacteria. Flow tests of underground main header piping are conducted every 5 years. Hydrants are opened up at the far corners of the plant and flow rates compared.

NMP-1 committed to implement the following items prior to the PEO in LRA Section A.1.4:

- Incorporate inspections to detect and manage loss of material due to corrosion into existing periodic test procedures.
- Specify periodic component inspections to verify that loss of material is being managed.
- Add procedural guidance for performing visual inspections to monitor internal corrosion and detect biofouling.
- Add requirements to periodically check the water-based fire protection systems for microbiological contamination.
- Measure fire protection system piping wall thickness using non-intrusive techniques (volumetric testing) to detect loss of material due to corrosion.
- Establish an appropriate means of recording, evaluating, reviewing, and trending the results of visual inspections and volumetric testing.
- Define acceptance criteria for visual inspections and volumetric testing.
- Develop new procedures and preventive maintenance tasks to implement sprinkler head replacements and/or inspections to satisfy NFPA 25, Section 5.3.1.

It was noted during the NMP-1 audit that tuberculation was observed in fire water branch piping during the flow tests. The staff noted that the tuberculation found in the NMP-1 FWS appears to be an aging effect that should be considered for inclusion in potential SLR guidance documents, as it was not included in Revisions 0, 1, or 2 of the LRGDs. The licensee indicated that there are repetitive observations of tuberculation and that this is an ongoing issue. (Following the audits at Ginna and NMP-1, NRC staff issued a draft LR-ISG (LR-ISG-2012-02) related to internal surfaces and corrosion under insulation that suggested revisions to AMPs XI.M27, XI.M29, XI.M36, XI.M38, XI.M42 and included tuberculation as an aging effect.) Other than tuberculation, degradation reported in CRs in recent years includes:

- Obstructions in fire water piping due to corrosion products or lake water silt (one CR in 2005)
- Through-wall leaks of fire protection piping (4 CRs in 2002-2004)
- UT readings of fire protection piping below minimum wall thickness (7 CRs)

In the fire water pressure maintenance subsystem, which pumps oxygenated city water, NMP-1 replaced CS piping with stainless steel (SS), and the diameter of the SS piping was increased. The previously 1.5-in. diameter CS piping was replaced with 2-in. SS piping.

2.3.27 XI.M29 Above Ground Metallic Tanks

Ginna implements this program through its AMP B2.1.1, "Aboveground Carbon Steel Tanks." The program consists of periodic visual examination by system engineers and a one-time limited UT examination of the tank bottoms. The AMP was written to conform to Revision 0 of the GALL Report and does not meet the guidance of AMP XI.M29 of the GALL Report, Rev. 2, which recommends follow-up UT every 5 years. Ginna performed a one-time limited UT inspection of the tank bottoms prior to the PEO in 2004 as indicated in the SER and LRA. It was noted during the audit that the AMP and associated implementing procedures do not address any follow-up examination of the tank bottom plates, even though a one-time inspection of the tanks in 2004, prior to the PEO, indicated loss of thickness of up to 20 percent due to corrosion. However, the wall loss observed was due to failed coatings on the accessible internal surfaces and was found during visual inspections. This internal coating has not been repaired. A UT examination of the tank bottom indicated that the outer surface (e.g., the underside, inaccessible area of the tank bottom where it is in contact with the concrete pedestal) is not displaying aging degradation. The tank bottom plates were not repaired or coated at that time, and no follow-up inspections were scheduled. The AMP owner stated that they are now scheduling follow-up UT inspections every 6 years.

At Ginna, the exterior surfaces of the tanks are periodically visually inspected by the system engineers. However, it was noted that no special training or qualification is required to conduct this inspection.

GALL Report AMP XI.M29, "Aboveground Carbon Steel Tanks," is not applicable to NMP-1. NMP-1 credits the existing plant-specific programs, AMP B2.1.32, "Preventive Maintenance Program," and AMP B2.1.33, "System Walkdown Program," for managing aging effects of aboveground metallic tanks. The B2.1.32 AMP provides for performance of various maintenance activities on a specified frequency based on vendor recommendations and operating experience. The scope of the program includes, but is not limited to, valve bodies, heat exchangers, expansion joints, tanks, ductwork, fan/blower housings, dampers, and pump casings. The aging effects of concern are detected by visual inspection and nondestructive examination (NDE) of components for evidence of defects and age-related degradation. Under this program, no adverse degradation of the aboveground metallic tanks has been detected. The audit found that the overall program appears to provide a reasonable framework for managing aging in the SSCs to which it is applied.

The Systems Walkdown Program at NMP-1 manages aging effects for accessible external surfaces of selected SSCs within the scope of license renewal. The specific aging effect of concern is loss of material from external surfaces of pumps, valves, piping, bolts, heat exchangers, tanks, expansion joints, electrical penetrations, electrical enclosures and cabinets, HVAC components, and other carbon steel components. Program activities include system engineer walkdowns (i.e., field evaluations of system components to assess system performance and material condition), evaluation of inspection results, and appropriate corrective actions. The frequency of inspections is at least once per refuel cycle for each structure and system.

2.3.28 XI.M30 Fuel Oil Chemistry

This program is implemented at Ginna through AMP B2.1.16, "Fuel Oil Chemistry." The Ginna AMP lists no enhancements to the GALL Report, Rev. 0, but lists two exceptions, that Ginna does not: (1) add biocides, stabilizers, or corrosion inhibitors to the fuel oil to mitigate corrosion; or (2) sample for particles in accordance with the modified American Society for Testing and

Materials (ASTM) D2276 test procedure. Particulate testing has subsequently been added the program, thereby eliminating this second exception.

The Ginna LRA states that the underground diesel fuel storage tanks have been drained and inspected annually until 1993 and annual pressure tests have been performed, with internal inspections performed on a 10-year frequency. The licensee later provided information that the tank draining, cleaning and inspecting tasks are included in the Preventive Maintenance Program Repetitive Tasks program and are performed every 9 years (six refueling outages), including supplemental ultrasonic examination (measurement of wall thickness) of locations where contaminants might accumulate, such as tank bottoms. No biological activity or evidence of degradation of the interior surfaces of either storage tank has been observed.

NMP-1 implements this program through its AMP B2.1.18, “Fuel Oil Chemistry Program.” This AMP takes the following exceptions to the GALL Report, Rev. 0: (a) NMP-1 uses only the guidance given in ASTM D1796 rather than in both ASTM D1796 and ASTM D2709 to determine the concentration of water and sediment in the diesel fuel oil tanks (these standards are applicable to fuel oils of different viscosities, and ASTM D 1796 is the standard that applies to the diesel fuel used at NMP-1); (b) NMP-1 takes an exception to using the modified ASTM D2276, Method A, which specifies a pore size of 3.0 μm, and NMP-1 uses a filter with a pore size of 0.8 μm, as specified in ASTM D2276; (c) NMP-1 takes an exception to multilevel sampling in the diesel fuel oil tanks (the physical configuration of the fuel oil tanks does not allow a representative fuel oil sample to be taken at multiple levels); and (d) NMP-1 takes an exception to periodically sampling the diesel fuel oil day tanks. These small tanks do not have a provision for sampling. Per Technical Specification Surveillance testing, the lower portion of the diesel fuel oil (where water and sediment would accumulate) is drained quarterly at NMP-1.

In addition, the following enhancements are noted in the NMP-1 AMP: (a) incorporate periodic tests for the presence of microbiological organisms at NMP-1; (b) provide guidelines for the appropriate use of biocides, corrosion inhibitors, and/or fuel stabilizers to maintain fuel oil quality; (c) add requirements to periodically inspect the interior surfaces of the NMP-1 emergency diesel fuel oil tanks and diesel fire pump fuel oil day tank for evidence of significant degradation (based on visual inspection for loss of material due to pitting, cracking, and corrosion), including a specific requirement that the tank bottom thickness be determined; (d) add a requirement for quarterly trending of particulate contamination analysis results; and (e) ensure acceptance criteria are specified in the implementing procedures for the applicable indications of potential degradation.

At NMP-1, the emergency diesel generator and diesel fire pump storage tanks are sampled and analyzed on a monthly or quarterly basis for water, sediment, and particulate contamination. The results are evaluated and included in a quarterly trending program. Additional fuel parameters that are periodically analyzed include American Petroleum Institute specific gravity, flash point, sulfur content, and carbon residue. Every 10 years (or sooner if UT thickness measurements indicate an adverse trend), each fuel oil storage tank is subjected to a condition inspection. An aging management inspection is performed which includes a structured visual inspection for loss of material due to pitting, cracking, crevice corrosion, galvanic corrosion, general corrosion, and MIC. UT examinations are also completed of the tank bottoms to determine wall thickness.

The NMP-1 LRA states that a review of plant-specific OpE revealed several incidents where contaminants (e.g., water, particulate) were detected through Fuel Oil Chemistry Program examinations. Numerous water and sediment analyses performed over a long operating period detected conditions that did not meet plant specifications. In each case, appropriate actions were taken. These actions included increased monitoring, backup samples, contamination removal, and tank cleaning. However, there have been no instances of fuel oil system component failures at NMP-1 attributed to contamination.

During the AMP audit, NMP-1 personnel stated that two UT inspections of the fuel oil tanks found regions where the local thickness due to pitting was less than the acceptance criterion of 0.3125 inches, and engineering evaluations were performed to verify the structural integrity of the tank. It was determined that the affected tank did not require repair or replacement.

2.3.29 XI.M31 Reactor Vessel Surveillance

This program is implemented at Ginna through AMP B2.1.28, "Reactor Vessel Surveillance." The Ginna AMP lists no exceptions or enhancements to the GALL Report, Rev. 0.

Section 4.0 of the Ginna PBD, Rev. 4, states that the licensee's reactor vessel surveillance program includes the following subprograms: (a) surveillance capsule insertion, withdrawal and evaluation; (b) fluence and uncertainty calculations; (c) monitoring of effective full-power years (EFPY); (d) development of pressure-temperature limit curves; and (e) calculation and monitoring of low-temperature overpressure protection (LTOP). In the Ginna LRA, the licensee indicated that, when capsules are removed, the neutron dosimetry data from the withdrawn capsules are evaluated to validate the fluence calculation. In addition, the PBD indicates that monitoring of EFPY is necessary to enable a projection of the fluence of the reactor vessel belt-line material as a function of time. The PBD further indicates that pressure-temperature (P-T) limit curves are normally developed based on a particular projection of EFPY, beyond which they are not valid. The PBD also indicates that EFPY calculations are performed at Ginna by using the daily reactor power log.

Ginna indicated that the last capsule (sixth capsule, P) is expected to be withdrawn approximately in 2018 after its exposure to the fluence level equivalent to that projected for the reactor vessel after 80 years operation.

NMP-1 implements this program through its AMP B2.1.19, "Reactor Vessel Surveillance Program." The NMP Reactor Vessel Surveillance Program takes no exceptions to the GALL Report, Rev. 0, but adds the following enhancements: (a) incorporate the requirements and elements of the integrated surveillance program (ISP), as documented in BWRVIP-116 and approved by NRC, or an NRC-approved plant-specific program, into the Reactor Vessel Surveillance Program, and include a requirement that if NMP surveillance capsules are tested, the tested specimens will be stored in lieu of optional disposal; and (b) project analyses of upper shelf energy and pressure-temperature limits to 60 years using methods prescribed by RG 1.99, Rev. 2, and including the applicable bounds of the data, such as operating temperature and cumulative neutron fluence.

In addition, the staff also required the following license condition:

> "Implementation of the most recent staff-approved version of the BWRVIP ISP as the method to demonstrate compliance with the requirements of 10 CFR Part 50, Appendix H. Any changes to the BWRVIP ISP capsule withdrawal schedule must be submitted for NRC staff review and approval. Any changes to the BWRVIP ISP capsule withdrawal schedule, which affects the time of withdrawal of any surveillance capsule, must be incorporated into the licensing basis. If any surveillance capsules are removed without the intent to test them, these capsules must be stored in manner which maintains them in a condition which would support re-insertion into the reactor pressure vessel, if necessary."

As part of its Reactor Vessel Surveillance Program, NMP-1 is participating in an ISP as described in BWRVIP-116. However, it was noted during the audit that the ISP provisions of BWRVIP-116 and BWRVIP-86-A were recently merged into BWRVIP-86, Rev. 1, which was approved by the NRC in October 2011 and superseded BWRVIP-116. During the audit interview, NMP-1 personnel indicated that their ISP is being updated to conform to the new guidance in BWRVIP-86, Rev. 1.

2.3.30 XI.M32 One-Time Inspection

This program was implemented at Ginna through its AMP B2.1.21, "One-Time Inspection." which identifies no exceptions or enhancements to the GALL Report, Rev. 0. NMP-1 implements this program through its AMP B2.1.20, "One-Time Inspection Program," and again identifies no exceptions or enhancements to the GALL Report, Rev. 0. However, the NMP-1 LRA included a commitment to develop and implement the One-Time Inspection Program prior to the PEO that also includes the attributes for a Selective Leaching of Materials Program. Both the Ginna and NMP-1 AMPs were new programs to be implemented prior to entering the PEO.

The regional IP 71003 inspections (IRs 05000244/2009007 and 05000244/2009009) specifically evaluated the results of the Ginna One-Time Inspection Program. The inspection report concluded that Ginna had performed the initial round of inspection required by the One-Time Inspection Program, and that Ginna had performed adequate evaluations of all inspections. The regional IP 71003 inspection (IR 05000220/2009007) specifically evaluated the results of the NMP-1 One-Time Inspection Program. The inspection report stated that NMP-1 had developed and implemented a One-Time Inspection program.

During the Ginna audit, an issue was raised about SCC of SS in an environment less than 140°F. The site identified multiple examples for thin-walled piping (Schedule 10) that showed sensitization of the weld HAZ. During discussions, licensee personnel said a new OpE document was not considered, since this problem did not meet the site's criteria for issuing OpE. The auditor noted that the staff should consider a need to add a new AMR line item in the GALL Report to address SCC of thin-walled SS piping at temperatures below 140°F.

It was noted during the audits that the One-Time Inspection Program provides a means to verify the performance of other AMPs (e.g., water chemistry control), where the environment in the PEO is expected to be equivalent to that in the prior 40 years, and for which no aging effects have been observed. The program description states that this AMP is applicable to situations where: (a) an aging effect is not expected to occur, but the data are insufficient to rule it out with reasonable confidence; or (b) an aging effect is expected to progress very slowly in the specified environment, but the local environment may be more adverse than generally expected. As documented in IR 20500044/2009007 and IR 05000244/2009009 for Ginna, three out of the 30 material/environment groups merited periodic inspections as a result of finding corrosion during the one-time inspections. These included cast iron in drainage raw water, carbon steel in raw water, and carbons steel in treated water. Ginna planned to perform these inspections through the Periodic Surveillance and Preventive Maintenance program. As documented in IR 05000220/2009007 for NMP-1, of the 13 material/environment groups established for the one-time inspections, only components in the carbon steel in treated water group merited periodic inspections, and these inspections were to be performed through the preventive maintenance program.

2.3.31 XI.M33 Selective Leaching

Ginna implements this program through its AMP B2.1.29, “Selective Leaching.” The Ginna AMP utilizes visual inspections performed under the Periodic Surveillance/Preventive Maintenance Program (AMP B2.1.23) and the One-Time Inspection Program (AMP B2.1.21) to determine if selective leaching is occurring in susceptible components. The program claims consistency with the GALL Report, Rev. 0, with the exception that hardness testing is not performed as part of the program. Instead, the feasibility of performing hardness tests and the value of hardness test data are assessed on a component-specific basis.

Visual inspections at Ginna identified one case of confirmed selective leaching in the gray cast iron drain plug of an auxiliary FW pump outboard bearing cooler. Evidence of degradation was also found on five other pumps but could not be definitely determined to be a result of selective leaching. Possible selective leaching was also found on multimatic valves on the underside of the clapper. As a result of these observations and in conformance with GALL Report AMP XI.M33, a plant-specific program has been developed whereby the components in question are inspected every quarter under the Ginna Preventive Surveillance and Periodic Maintenance program. If follow-on destructive examinations verify selective leaching in one of the suspect pumps, all six pumps will be replaced with cast steel pumps.

The NMP-1 AMP B2.1.21, “Selective Leaching Program,” was identified as a new program in the LRA and was implemented through the One-Time Inspection Program. The NMP-1 LRA included a commitment to develop and implement the One-Time Inspection Program prior to the PEO that also included the attributes for a Selective Leaching of Materials Program.

The NMP-1 PBD, Rev. 0, provides considerable detail as to the SSCs, materials, and environments to which the program applies, but it was not clear about inspection techniques. For example, in Table 5.0-1, “GALL Consistency Review,” of the PBD, the assessment of consistency under “Parameters Monitored/Inspected” states, “the program will provide direction for visual inspection of susceptible, internal SSC surfaces.” It further states, “field hardness testing due to the capabilities of portable equipment and efforts necessary to qualify material-specific test procedures is not planned on site.” However, under “Detection of Aging Effects” of the same table, the assessment of consistency states, “where practical, field hardness testing will be performed in lieu of off-site testing.” In the audit interview, the licensee clarified that field hardness testing is performed where practical. Attachment 2, “Operating Experience Review,” to the PBD also makes it clear the field hardness testing has been performed at NMP in the past for other purposes. As a result of the size and geometry of the portable tester, there are limited locations where it is able to be used. That is why there is the apparent inconsistency between the table and the attachment. NMP-1 established four material/environment groups (i.e., susceptible copper alloys and gray cast iron) in treated and raw water, comprising over 340 components. It inspected 25 copper alloy and 29 gray cast iron components. The samples were selected randomly following EPRI guidance on an appropriate sample size. No selective leaching was detected in this inspection, though condition reports were written for other conditions such as MIC and fouling. One destructive evaluation was conducted later on a copper alloy component, which determined that no leaching was present. However, the component was found to contain less than 15 percent zinc, and was therefore not susceptible. Based on this destructive evaluation, 12 other copper alloy samples, selected in the sampling plan as described above, were determined to be insusceptible to leaching.

2.3.32 XI.M35 One-Time Inspection of ASME Code Class 1 Small-Bore Piping

The Ginna and NMP-1 LRAs were prepared under GALL Report, Rev. 0, guidance and do not include a separate AMP for the inspection of ASME Code Class 1 small-bore piping. The Ginna LRA manages the aging of small-bore piping through its AMPs “One-Time Inspection” and “Water Chemistry Control.” Similarly, the NMP LRA manages this aging effect through its “One-Time Inspection Program,” “Water Chemistry Control Program,” and “ASME Section XI Inservice Inspection (Subsections IWB, IWC, IWD) Program.” Therefore, this AMP was not reviewed during the audits.

2.3.33 XI.M36 External Surfaces Monitoring of Mechanical Components

The license renewal process for both Ginna and NMP-1 was carried out under the GALL Report, Rev. 0, which did not include this AMP but instead called for a plant-specific program. The plant-specific AMP applied at Ginna was the AMP B2.1.33, “System Monitoring Program,” and that at NMP-1 was the “Systems Walkdown Program,” AMP B2.1.33.

At Ginna, quarterly walkdowns are conducted for all accessible systems. Walkdowns for systems within containment are conducted at every refueling outage and during any shutdown opportunity. The program covers the RCS, safety injection, containment spray, residual heat removal (RHR), chemical volume and control system (CVCS), CCCW, SFP, cooling and fuel storage, main and auxiliary steam system, feedwater and condensate system, auxiliary steam system, service water system, fire protection system, and others. The purpose of the AMP is to monitor and assess, primarily through visual examination, the condition of the external surfaces of SSCs in the scope of license renewal, including polymeric materials. Based on discussions with the Ginna personnel during the audit and the CRs made available, the program appears to be primarily concerned with the visual detection of leakage, rust and corrosion, and coating degradation on the external surfaces of accessible components.

There were a large number of findings at Ginna during the first quarterly report for trending corrective action reports, but the number has declined significantly in the following quarterly reports and semi-annual trending reports that were reviewed during the audit. However, Ginna does not count corrective action reports if the condition has been previously observed and reported but not corrected. Its most predominant aging effect has been boric acid corrosion.

The Systems Walkdown Program at NMP-1 manages aging effects for accessible external surfaces of a variety of systems and components within the scope of license renewal through visual inspections that are performed at least every 2 years in conjunction with the plant’s refueling cycle. For components accessible during operation, inspections are performed more frequently, apparently on a case-by-case basis. During the audit interview, NMP-1 personnel emphasized that the program involves visual inspection only and does not include, for example, manual probing and manipulation of elastomers or any other kinds of hands-on inspections. The inspectors follow pre-defined checklists, and visual inspections are enhanced where necessary using supplemental illumination, hand-held magnifiers, and binoculars. Inspectors do not climb up on components or use ladders during inspections. Where components are not accessible because of mechanical interference or high radiation fields, remote cameras are sometimes used. The acquisition of a robotic camera is under consideration, but there are concerns that, should it become radioactively contaminated, the utility of this costly system would become greatly limited. The licensee stated that, for most inaccessible components, the potential for the presence of degradation is inferred from observations on similar accessible components operating under the same environment.

The sort of degradation observed to date at NMP-1 has been relatively minor and is limited primarily to modest surface rust and corrosion and occasional small leaks. The licensee stated that degradation does not appear to be accelerating with time but is more or less steady state, though longer-term extended operation is needed to more accurately assess this trend. In one case, extensive rusting observed on the external surfaces of piping through visual inspection was followed up with extensive UT examinations to verify that it was nothing more than a surface effect.

2.3.34 XI.M37 Flux Thimble Tube Inspection

The GALL Report AMP XI.M37, “Flux Thimble Tube Inspection,” is not applicable to NMP-1 since it is a BWR. This program is implemented at Ginna as a plant-specific AMP B2.1.36, “Thimble Tube Inspection Program,” in its LRA. The implementation at Ginna uses NRC Bulletin 88-09, “Thimble Tube Thinning in Westinghouse Reactors,” July 26, 1988, as its basis, and it includes a license renewal commitment (No. 39, Appendix A of SER Report NUREG-1786) to include inspections for SCC and wear during each outage, since cracking due to SCC was previously detected in certain regions of the thimble tubes.

The GALL Report, Rev. 0, did not include this program, and Revisions 1 and 2 of the GALL Report address only the wear loss of the tube wall as the aging effect. Ginna’s implementation of the OpE and inspections for SCC/IGA (intergranular attack) is thus an enhancement to GALL Report AMP XI.M37. During the Ginna audit, the staff confirmed this OpE and that the licensee’s corrective action of periodic flushing of the thimble-tube-to-guide-tube annuli was an appropriate response to address this aging effect in addition to tube wear.

With regard to the wall loss due to wear as the aging effect managed under this AMP, the Ginna audit review of licensee’s inspection results described in its PBDs (1999-2008) indicated that the licensee had replaced five thimble tubes in four locations and that all thimble tubes show acceptable wear levels against the acceptance criteria. This is considered indicative of the AMP’s performance in identifying and managing this aging degradation process. The licensee provided the following information after the audit: during the 2011 RFO, all 36 thimble tubes, as well as seal table subcomponents, were replaced. The previous 304SS tubes were replaced with more SCC resistant 316SS, and the portions of the tubes that were susceptible to wear were chrome-plated to mitigate wear. With the completion of this modification, a commitment change was processed to change the thimble tube inspection frequency, beginning in 2014, to every 3rd RFO instead of every RFO.

2.3.35 XI.M38 Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components

The license renewal process for both Ginna and NMP-1 was carried out under the GALL Report, Rev. 0, which did not include this AMP but instead called for a plant-specific program. The plant-specific AMP applied at Ginna was AMP B2.1.23, “Periodic Surveillance and Preventive Maintenance,”, and that at NMP-1 was AMP B2.1.32, “Preventive Maintenance Program.” The Ginna LRA states for the Periodic Surveillance and Preventive Maintenance program (Program Elements 3 (“Parameters Monitored/Inspected”), 4 (“Detection of Aging Effects”), and 6 (“Acceptance Criteria”)), that “operations, maintenance, and surveillance test procedures and task descriptions will be enhanced to provide explicit guidance on detection of applicable aging effects and assessment of degradation.”

The NMP-1 LRA identifies the following enhancements to the NMP-1 Preventive Maintenance Program:

- Expand the Preventive Maintenance Program to encompass activities for certain additional components, identified as requiring aging management, and explicitly define the aging management attributes, including the systems and the component types/commodities included in the program.
- Specifically list those activities credited for aging management.
- Specifically list parameters monitored.
- Specifically list the aging effects detected.
- Establish a requirement that inspection data be monitored and trended.
- Establish detailed parameter-specific acceptance criteria.

During the license renewal process, NMP-1 committed to making enhancements to the Preventive Maintenance Program to revise existing procedures. These enhancements would provide the level of detail and specificity needed for staff review of the Preventive Maintenance Program. They would affect the main program elements including “Scope of Program,” “Preventive Actions,” “Parameters Monitored,” “Detection of Aging Effects,” “Monitoring and Trending,” and “Acceptance Criteria.” The Periodic Surveillance and Preventive Maintenance program at Ginna is an existing plant-specific program that uses visual and volumetric inspections of selected equipment items and components for evidence of aging-related degradation on a specified frequency based on operating experience. Inspections of piping and components for leakage are also performed on selected systems. Eddy current testing of tubing is used for inspecting heat exchangers and coolers within the scope of license renewal. Polymeric materials such as seals, gaskets, flexible collars, expansion joints, rubber boots, etc., in certain ventilation system components are also periodically inspected. This program is most closely aligned to AMP XI.M38 of the GALL Report, Rev. 2, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components,” but it is a much broader program in that, in addition to piping and ducting, it includes visual and volumetric inspections of pumps, heat exchangers, valves, seals, gaskets, and similar components.

The Preventive Maintenance Program at NMP-1 differs from its plant-specific Systems Aging Walkdown Program discussed above. The Walkdown Program is confined to the visual examinations of accessible external surfaces, whereas the Preventive Maintenance Program employs a variety of visual and NDE inspection techniques designed to detect both surface and volumetric aging effects. The PBD for this AMP provides a detailed listing of the systems, components, environments, and aging effects to which this AMP applies and lists in detail the plant-specific, supporting-program-implementing documents. The description of “Parameters Monitored/Inspected” element in PBD Table 5.0-1 clarifies that, despite its name, the program encompasses much more than simple preventive maintenance and utilizes a variety of visual and NDE inspection techniques. Inspections are largely performed on a 2-year basis as dictated by the NMP-1 refueling cycle, since many of the SSCs managed by this AMP are accessible only during refueling outages.

There has been only one significant adverse finding at NMP-1, and that was in a retired/abandoned-in-place component in which the pump casing and connections showed signs of corrosion. The pump is to be disconnected so it will no longer be in the scope of license renewal. Corrosion of some pump coatings has also been observed, and these coatings have been replaced. If similar corrosion is observed on inspections of similar pumps, the inspection sample population size will be increased.

During the NMP-1 audit, the plant owner of the program stated that he maintains a detailed set of spreadsheets to track any changes with time. The inspection frequency is largely dictated by the plant's 2-year refueling cycle, and, as noted above, inspection sample sizes and techniques employed appear to be based on the results of previous inspections and observed trends.

The Ginna program has produced a number of condition reports from the inspections, and observations from these reports are fed back to their respective programs. When significant corrosion or other degradation is observed, the inspection frequency is increased. A significant number of pipe replacements have resulted from observations in this program.

2.3.36 XI.M39 Lubricating Oil Analysis

The license renewal process for both Ginna and NMP-1 was carried out under the GALL Report, Rev. 0. That edition of the GALL Report mentions lubricating oil with contaminants and/or moisture as a possible operating environment for several components, but it contains no AMP-related to Lubricating Oil Analysis. Consequently, neither the Ginna LRA nor the NMP-1 LRA provides an AMP on Lubricating Oil Analysis. The Ginna LRA mentions the aging management of oil coolers in the auxiliary FW system in contact with contaminated lubricating oil and lists its Periodic Surveillance and Preventive Maintenance program as the applicable AMP. The NMP LRA lists a number of components in contact with lubricating oil, but makes no mention of possible contamination and identifies no aging effect.

No audits of AMPs dealing with lubricating oil analysis were conducted at Ginna or NMP-1.

2.3.37 XI.M40 Monitoring of Neutron Absorbing Materials Other than Boraflex

Ginna implements this program through its AMP B2.1.30, "Spent Fuel Pool Neutron Absorber Monitoring," which is similar in scope to AMP XI.M40 of the GALL Report, Rev. 2, "Monitoring of Neutron-Absorbing Materials Other Than Boraflex." Ginna uses soluble boron and borated stainless steel for neutron absorption; existing Boraflex in the SFP is not credited and thus is not age-managed. Ginna's B2.1.30 AMP monitors long-term performance of the borated stainless steel (BSS) panels using surveillance coupons comprised of the same material. As stated above, Ginna also incorporates Boraflex panels in the SFP. However, reliance on the neutron absorption capability of the Boraflex panels was discontinued when the NRC approved License Amendment 79 on December 7, 2000.

Ginna's program uses BSS coupons mounted on a surveillance tree in the SFP. These samples are removed for visual examinations for signs of corrosion or blistering, and physical measurements of thickness and weight, for comparison to pre-operational photographs of surface condition and measurements. Samples are removed, examined, and returned to the surveillance tree every three refueling outages, by "qualified personnel." The BSS coupon samples have been examined in 2000, 2006, and 2010, and no degradation was found in any evaluated parameter. The visual and quantitative observations have identified no changes from the pre-operational conditions. Ginna has reviewed the NRC Information Notice (IN) 2009-26, "Degradation of Neutron-Absorbing Materials in the Spent Fuel Pool," and determined that no changes were needed in the AMP.

As stated in Section 2.3.21, the NMP-1 SFP had eight Boraflex racks in its SFP. Only two racks made of Boraflex currently exist in the NMP-1 SFP. Two re-rack campaigns were performed in 1999 and 2004, which replaced most of the original Boraflex and non-poison racks with Boral racks. NMP-1 credits its existing AMP B2.1.12, "Boraflex Monitoring Program," for managing aging effects of Boraflex racks; however, the Boral racks are monitored based on a specific commitment made to the NRC during the licensing of the rack expansion and redesign to the use of Boral. Findings and evaluation of NMP-1's "Boraflex Monitoring Program" AMP are contained in Section 2.1.21, XI M22, "Boraflex Monitoring," of this report.

2.3.38 XI.M41 Buried and Underground Piping and Tanks

This program is implemented at Ginna through AMP B2.1.7, "Buried Piping and Tanks Inspection," and AMP B2.1.28, "Buried Piping and Tanks Surveillance." Neither of these AMPs state any exceptions or enhancements to the GALL Report, Rev. 0, nor are any commitments identified. After Ginna clarified during the license renewal process that the inspection of buried tanks and piping is carried out under the Ginna One-Time Inspection program, the staff found the Ginna Buried Piping and Tanks Inspection program to be acceptable, as submitted in the LRA. The licensee stated after the audit that the AMP was subsequently changed to be consistent with AMP XI.M34 in the GALL Report, Rev. 0. This was done before entry into the PEO and was included in the Region's IP 71003 inspection. Additionally, the AMP has since been revised on a fleet basis to be consistent with the NEI 09-14 initiative ("Guideline for the Management of Buried Piping Integrity") as mandated by the Nuclear Strategic Issues Advisory Committee (NSIAC).

According to the Ginna SER, Section 2.3.2.3.1, Ginna relies on its Periodic Surveillance and Preventive Maintenance program to carry out inspections of underground piping and tanks, and these inspections are performed on an opportunistic basis. No directed periodic inspections are indicated in the Ginna AMP, and this was confirmed by the Ginna program owner during the audit interview. However, the NMP-1 LRA includes a commitment to excavate degradation-susceptible areas to perform focused inspections if an opportunistic inspection has not occurred within the past 10 years at the time of initial license renewal.

NMP-1 implements this program through its AMP B2.1.22 "Buried Piping and Tanks Inspection Program". This AMP identifies no exceptions or enhancements to AMP XI.M34 in the GALL Report, Rev. 0. The following commitment is stated: "Develop and implement a Buried Piping and Tank Inspection Program which includes a requirement that if an opportunistic inspection does not occur within the first ten years of extended operation, NMP-1 will excavate a representative sample for the purpose of inspection." This commitment was to be met prior to entering the PEO.

The NMP-1 PBD for this AMP initially developed per the GALL Report, Rev. 0, was revised to meet the requirements of the GALL Report, Rev. 1, in 2006. The new program includes a requirement that before entry into the PEO, if an opportunistic inspection has not occurred within the past ten years, NMP-1 will excavate degradation-susceptible areas to perform focused inspections. The program was initially established due to license renewal requirements, and has been expanded in response to industry issues related to buried-piping components.

A new procedure NEP-BPT-INSP-01, Rev. 0, "Buried Piping and Tanks Inspection Program" was created in 2007 to provide instructions for implementing the LR Buried Piping and Tanks Inspection Program at NMP-1. Development of this procedure satisfied the commitment mentioned above.

This NMP-1 AMP is intended to meet the requirements of the NSIAC Buried Piping Integrity Initiative and NEI 09-14, "Guideline for the Management of Buried Piping Integrity." It was stated during the audit that NMP-1 is in the process of revising this procedure. It was also stated that the underground pipe and tank program continues to be enhanced. Systems and components included in the program have been identified and risk-ranked, and an inspection plan in accordance with the risk ranking results and the NSIAC initiative has been developed.

Asbestos cement pipe was initially excluded from the scope of the NMP-1 program but later added to meet the NSIAC scope.

A visual inspection of a hydrant, standpipe, and its associated buried isolation valve at NMP-1 was completed in 2007. The piping was asbestos cement material. The inspection found the piping to be in exceptionally good condition with no aging effects noted. Soil samples that came into contact with the various components were taken and analyzed, and the corrosion potential was found to be low for the cement pipe and moderate for the steel pipe. The inspection team identified that this inspection location was not a high-risk location because it was above the water table.

In September 2011, a CR was initiated due to a failure of a buried city water cement/asbestos pipe at NMP-1. The event was determined to be a singular random event failure due to foreign object impingement on the piping (large rock in original construction backfill that impinged on piping due to excessive overhead loading during the past heavy haul movements). In addition, DER2003-1319, "Overall Assessment of the Significant of Nine Mile Point Fire Water System Corrosion," identified piping and valve corrosion and leaks in several areas as a result of internal piping degradation. None of the defects found represented an impending failure of fire water system piping or valves.

2.3.39 X.M1 Fatigue Monitoring

The NMP-1 Fatigue Monitoring Program (FMP) is an existing program that manages cracking due to the cyclic fatigue of carbon steel, low alloy steel, stainless steel, and nickel alloy components. The FMP manages the fatigue life of reactor coolant pressure boundary components by tracking and evaluating key plant events. Events were selected based upon plant-specific evaluations of the most fatigue-limited locations for critical components, including those discussed in NUREG/CR-6260. The FMP monitors operating transients, calculates cumulative usage factors, and directs performance of engineering evaluations to develop preventive and mitigative measures to ensure that the design limit on fatigue usage is not exceeded. The effects of reactor coolant environment are considered through the evaluation of, as a minimum, those components selected in NUREG/CR-6260 using the appropriate environmental fatigue factors.

In 1999, prior to submitting the LRA, the NMP engineering personnel discovered that several transients affecting the NMP-1 reactor pressure vessel recirculation inlet and outlet nozzles were not required to be tracked per the FMP. An analysis of the fatigue effects of these additional cycles was performed and the fatigue usage contribution of the cycles was found to be relatively small. However, these seven transients have been added to the list of transients that must be tracked for NMP-1.

The OpE at NMP-1 showed that cracking was detected in a FW nozzle in 1977. The NMP-1 and industry experience on FW nozzle cracking has demonstrated the potential of this location to accumulate significant fatigue usage during plant operation. The staff noted that the licensee's use of stress-based fatigue methodology for the FW nozzle is adequate for calculating fatigue usage factors for the component, based on its heavy fatigue duty and past cracking experience. The staff also noted that a self-assessment of the FMP indicated that, in 2009, the recirculation nozzles were reanalyzed satisfactorily using all six directional stressors as input to the Green's Theorem portion of the overall fatigue analysis algorithm (addressing the NRC concerns in RIS 2008-30) and the cumulative usage factor (CUF) was less than 1.0 as required by the ASME code.

The FMP at Ginna is consistent with Section X.M1 of the GALL Report, "Metal Fatigue of Reactor Coolant Pressure Boundary." The Ginna SER for license renewal does not identify any exceptions or enhancements for this AMP in comparison to the GALL Report, Rev. 0, program. The program monitors loading cycles due to thermal and pressure transients for selected critical components to maintain the fatigue usage factor below the design code limit of 1.0, including the effects of reactor water environment. The scope of the FMP includes the plant systems and components for which a cyclic or fatigue design basis exists. The specific systems and components include:

- Reactor pressure vessel closure studs
- Reactor pressure vessel primary (inlet and outlet) nozzles
- Reactor pressure vessel at core support pad
- Steam generator tubesheet
- Cold leg (accumulator) safety injection nozzle
- Pressurizer upper shell and spray nozzle
- Pressurizer surge line nozzle
- Hot leg surge line nozzle
- Pressurizer surge line
- Pressurizer heater well penetration
- Reactor coolant piping charging system nozzles
- Residual heat removal hot leg suction nozzles
- Residual heat removal system Class 1 piping

2.4 <u>AMPs for Structures</u>

This section describes the AMPs related to structures (also see Table A.5), including the AMPs numbered XI.S1 through XI.S6 in Chapter XI of the GALL Report, Rev. 2, one AMP associated with management of TLAAs related to adequacy of containment tendon prestress (X.S1 "Concrete Containment Tendon Prestress"), and two plant-specific AMPs developed by NMP-1. The program description of the AMP is intended to summarize, in no more than a few paragraphs, the aging effect to be managed, the aging mechanism(s) responsible for this effect, the overall approach proposed to manage this aging effect, and the technical basis for this approach (as noted in Table 2.1). In general, the program descriptions provided in the Ginna and NMP-1 AMPs for structures, which were prepared under GALL Report, Rev. 0, guidance, met these objectives. Furthermore, the SRP-LR, Rev. 2, states that this program element should include the specific structures and components that are subject to an aging management review. The Ginna and NMP-1 AMPs generally satisfied this provision as well. Table A.5 illustrates the relationship between the structural AMPs as reviewed during the Ginna and NMP-1 audits.

2.4.1 XI.S1 ASME Section XI, Subsection IWE

Ginna implements GALL Report AMP XI.S1 (ASME Section XI, Subsection IWE), combined with AMP XI.S2 (ASME Section XI, Subsection IWL) and AMP XI.S4 (10 CFR 50 Appendix J), through its existing AMP B2.1.3, "ASME Section XI, Subsections IWE & IWL Inservice Inspection." Ginna has a prestressed concrete containment, and Ginna's IWE/IWL Program manages aging of (a) steel liners of concrete containments and their integral attachments; containment hatches and airlocks; seals, gaskets, and moisture barriers, and pressure retaining bolting; and (b) reinforced concrete containments and unbonded post-tensioning systems. Visual examinations are performed with limited supplemental volumetric and surface examinations as necessary. Tendon anchorages and wires are visually examined. Tendon wires are tested to verify that minimum mechanical properties requirements are met. The tendon corrosion protection medium is analyzed for alkaline content and soluble ion concentrations. Prestressing forces are measured in randomly selected sample tendons. Ginna has a separate AMP, AMP B3.3, “Concrete Containment Tendon Prestress,” for managing TLAA to address loss of tendon prestressing (see Section 2.4.9 of this report). The Ginna IWE/IWL AMP also incorporates 10 CFR Part 50 Appendix J containment leak rate tests.

The Ginna LRA indicates the following plant-specific experience:

- Loss of pre-stress in most containment tendons requiring re-tensioning of 137 tendons
- Containment moisture barrier found to be out of conformance with design drawing; loose insulation; non-conformance corrected by recaulking
- Minor corrosion of steel containment liner; wall thickness verified by UT; restoration of protective paint coating
- Low grease levels in certain tendon grease cans at top of containment; cans refilled
- Corroded and leaking tendon fill-port piping; all fill ports repaired

The Ginna containment is unique compared to a regular prestressed concrete containment. The vertical tendons are anchored at the base to rock anchors by bellows. In addition, there are neoprene pads embedded in the concrete at the base and spring line of the containment. This unique design required some additional surveillance requirements for the prestressing tendons and containment pressure tests. The containment liner plate at Ginna is covered with insulation between the base slab and a point 10 feet above the spring line. This situation required removal of insulation at the moisture barrier in the suspected area at the base slab to inspect the liner plate.

Major AMP implementation gaps and observations from the audit include:

- Ginna’s IWE/IWL program was written based on the GALL Report, Rev. 0.
- The AMP basis document has not been updated; the program is currently being implemented in accordance with ASME 2004 code; however, the basis document still referenced the 1995 edition of the code.
- Neoprene pads are not inspected during surveillance activities.
- The licensee photographed the whole of the containment surface as a baseline record prior to the PEO in 2002-2003.
- Ginna installed fiber optic strain gages on 20 of the 160 tendons.

NMP-1 has a Mark-I steel containment. NMP-1 implements GALL AMP XI. S1 through its AMP B2.1.23, “ASME Section XI Inservice Inspection (Subsection IWE) Program.” This is an existing program that manages aging effects due to corrosion of carbon steel components comprising the NMP-1 containment pressure boundaries. The NMP-1’s IWE program is supplemented by two additional plant-specific programs, “Drywell Supplemental Inspection Program” and “Torus Corrosion Program.” The former is used to manage general corrosion in six localized areas of the drywell exposed to aggressive cleaning chemicals. The latter manages corrosion of the torus and its support structures. The IWE program also monitors the condition of the drywell sand cushion area.

The containment surfaces are inspected for degradation and corrosion. The drywell sand cushion area was inspected in 1995 and 2007 using a borescope. The drains were found to be open with no trace of water or corrosion. There is no plan for additional borescope examination during PEO. However, the openings in the drain lines in the torus room are inspected during every outage.

The acceptance criteria for the NMP-1 containment inspection program consist of the following elements:

1. The projected containment wall thickness at the end of PEO should be greater than the minimum design wall thickness. The wall thickness and corrosion rate (mils/year) should be periodically measured in accordance with IWE requirements.
2. Torus shell thickness should not be less than the required thickness through the PEO.
3. Acceptance criteria of local wall thickness and average wall thickness, and conservative corrosion rates should be established. The minimum wall thickness and the maximum corrosion rate limits should be defined to ensure that the minimum wall thickness requirement will not be violated before the next scheduled inspection.

Major observations from the NMP-1 audit include:

1. The torus is uncoated, and its thickness has reduced in isolated local pits to less than 10 mils more than minimum design thickness. The licensee provided the following clarifying information after the audit. The Torus Corrosion Monitoring Program is being conducted per NRC-approved guidance in the SER that it generated after reviewing the program. NMP-1 has recognized that coating the torus is a contingency that may be needed if and when the plant applies for license renewal beyond 60 years. At the current corrosion rate, which is recalculated after every RFO following the requisite torus inspections, the minimum design thickness will not be reached at those worse case locations by the time the plant life reaches 60 years.
2. NMP-1 monitors torus thickness of the underwater surface by external UT of the pre-selected areas, and measuring corrosion rate of coupons installed in the torus. It was noted that this procedure may miss the detection of localized corrosion such as pitting.

2.4.2 XI.S2 ASME Section XI, Subsection IWL

Ginna has a prestressed concrete containment. As stated in Section 2.4.1, Ginna combines this program with GALL XI.S1 (ASME Section XI, Subsection IWE) and AMP XI.S4 (10 CFR 50, Appendix J) through its AMP B2.1.3, “ASME Section XI, Subsections IWE & IWL Inservice Inspection.” In addition, Ginna has a separate TLAA AMP B3.3, “Concrete Containment Tendon Prestress,” for managing loss of tendon prestressing. Ginna’s IWE/IWL AMP also manages 10 CFR Part 50, Appendix J, containment leak rate tests. NMP-1 has a Mark I steel containment, and thus this program is not applicable.

Ginna’s IWE & IWL program consists of (a) periodic visual inspections of concrete surfaces for the prestressed concrete containment, (b) periodic visual inspections and sample tendon testing of unbonded post-tensioning systems for evidence of degradation, and (c) assessment of damage and corrective actions. Measured tendon lift-off forces are compared to the predicted tendon forces calculated in accordance with RG 1.35.

The evaluations of Ginna's IWL/IWE program regarding the prestressed containment and prestressing tendon systems are described in Sections 2.4.1 and 2.4.9 of this report. Observations in Ginna's IWE AMP, described in Section 2.4.1, also apply here, including:

- The AMP basis document has not been updated.
- The program is currently being implemented in accordance with ASME 2004 code in accordance with 10 CFR 50.55a; however, the basis document referenced the 1995 edition of the code.

2.4.3 XI.S3 ASME Section XI, Subsection IWF

Ginna implements this program through its AMP B2.1.4, "ASME Section XI, Subsections IWF Inservice Inspection," and NMP-1 through its existing AMP B2.1.25, "ASME Section XI Inservice Inspection (Subsection IWF) Program."

Ginna's IWF program consists of periodic visual examinations of component supports for evidence of degradation. The program provides for evaluation of inspection results and appropriate corrective actions. It was noted during the audit that a license renewal commitment regarding volumetric (UT) examination of the high-strength bolts in the SER was eliminated by a 10 CFR 50.59 evaluation. The licensee indicated that the high-strength bolts were replaced due to potential or actual SCC, and the licensee has used a 10 CFR 50.59 approach to eliminate the commitment to perform UT examination of the high-strength bolts. The basis for this change was based on ASME Subsection IWF and plant-specific operating experience. The PBD, LR-IWF-PROGPLAN, cites the operating experience for high-strength bolt failures and their removal. The 56 bolts were tightened using a standard stud wrench, which eliminated the excessively high pre-load. Inspections during subsequent outages revealed no evidence of bolt distress.

Other observations from the audit of Ginna's IWF AMP include:

- The licensee cleaned and painted all component anchor bolts located in the sub-basement to inhibit corrosion.
- The AMP basis document has not been updated. The program is currently being implemented in accordance with ASME 2004 code; however, the basis document still references the 2001 edition of the code.
- The licensee has not revised the program to incorporate GALL Report, Rev. 1 or 2, recommendations. The GALL Report, Rev. 2, is augmented to include monitoring of high-strength structural bolting based on NUREG-1339 and industry recommendations. The Ginna IWF AMP was developed based on the GALL Report, Rev. 0.

The NMP-1 IWF Program is an existing program that manages aging of carbon steel component and piping supports, including ASME Class MC supports, due to general corrosion and wear. Program activities include visual examinations to determine the general mechanical and structural condition of components and their supports. The program is based on ASME Section XI (Subsection IWF) for ISI of supports; it implements the alternate examination requirements of ASME Code Case N-491-1 endorsed by RG 1.147, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1."

It was noted that the NMP-1 IWF AMP does not include inaccessible piping supports. This may be attributed to the fact that the GALL Report IWF AMP only recommends inspection of piping and components supports that are not exempt from ASME IWF-1230 and MC supports. The Scope of Program in the GALL Report, Rev. 2, states, "This program addresses supports for

ASME Class 1, 2, and 3 piping and component supports that are not exempt from examination in accordance with IWF-1230 and MC supports." Exemptions, as stated in IWB-1220, include portions of supports that are inaccessible due to being encased in concrete, buried underground, or encapsulated by guard pipe. Note that inaccessible components are included in the scope of GALL AMP XI.S2, "ASME Section XI, Subsection IWL," which states that the licensee is to evaluate the acceptability of inaccessible areas when conditions exist in accessible areas that could indicate the presence of or result in degradation to such inaccessible areas. The licensee later clarified that the IWF program is based on the requirements of the current version of the code per 10 CFR 50.55a.

Other observations from the audit of NMP-1's IWF AMP include that the most recent quarterly Health Reports of the ISI Program (July–September 2011) rates the program as ACCEPTABLE and GREEN.

2.4.4 XI.S4 10 CFR 50, Appendix J

As stated in Section 2.4.1, Ginna implements this program through its AMP B2.1.3, "ASME Section XI Subsections IWE & IWL Inservice Inspection." Ginna uses the containment IWE/IWL program and containment leak rate testing to manage the aging effects of cracking and corrosion for penetration sleeves, bellows, and dissimilar metal welds, corrosion, and loss of leak tightness due to wear of personnel airlock and equipment hatch, and loss of sealant and leakage in containment seals, gaskets, and moisture barriers. Additionally Ginna's AMP B2.1.23, "Periodic Surveillance and Preventive Maintenance," also requires visual inspections of hatches, hinges, locks, and closure mechanisms, as well as elastomeric seals associated with the containment air locks. It is also credited for managing the aging effects of loss of material due to corrosion and loss of leak tightness due to mechanical wear of locks, hinges, and closure mechanisms.

The Ginna LRA states that its containment program implements and formally adopts the requirements of the ASME Section XI, Subsections IWE & IWL ISI, programs as part of the Ginna ISI Program. Included in the scope of the IWE program are the exposed portions of the containment liner, the liner for the fuel transfer penetration, all other penetrations, associated bolting, moisture barriers, and all airlocks, seals, gaskets, and penetration bellows previously included in the scope of Appendix J.

During the Ginna LRA review, the licensee committed to perform two structural integrity tests at design pressure during PEO in 2015 and 2026. The staff noted that the licensee has revised this commitment by using the 10 CFR 50.59 screening process to align the schedule with the integrated leak rate test (ILRT).

NMP-1 implements the GALL Report XI.S4 AMP through its existing "10 CFR 50 Appendix J Program," which detects degradation of the containment structure and components that comprise the containment pressure boundary. Containment leak rate tests are performed to assure that leakage through the primary containment and systems and components penetrating primary containment do not exceed allowable leakage limits specified in the Technical Specifications. This program complies with the Option B requirements of 10 CFR Part 50 Appendix J, with plant-specific exceptions approved by the NRC as part of license amendments, and it implements the guidelines provided in NRC RG 1.163 and NEI 94-01.

Incidents of containment leakage that have been detected and documented in the NMP-1 basis document include:

- Leakages on the main steam penetration bellows were detected by Type B test due to cracks in the HAZ of seam welds.
- Containment interior wall leak paths were identified through Type A tests.
- Torus leakages have been reported due to fatigue in the proximity of the high-pressure coolant injection (HPCI) system line.

The NMP-1 basis document indicated that Type C test leakages (involving the containment isolation valve) are the most common leakage events, and typical corrective actions involve valve disc-to-seat maintenance to improve leak-tightness. The basis document also indicated that Type B tests are sufficiently sensitive to identify degraded components that impact component leak-tightness requiring corrective actions.

Containment leakage events have been detected and documented and corrective actions were taken.

2.4.5 XI.S5 Masonry Walls

Ginna implements GALL Report AMP XI.S5 (Masonry Walls), combined with AMP XI.S6 (Structures Monitoring) and AMP XI.S7 (RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants), through its existing AMP B2.1.32, "Structures Monitoring Program." NMP-1 implements this program through its existing "Masonry Wall Program," AMP B2.1.27. Masonry walls are used as fire barriers at Ginna. The Ginna Structures Monitoring Program includes masonry walls evaluated in accordance with NRC Inspection & Enforcement Bulletin (IEB) 80-11, "Masonry Wall Design" and incorporates IN 87-67, "Lessons learned from Regional Inspections of Licensee Actions in Response to IE Bulletin 80-11." Visual examination of masonry walls at Ginna is performed at 5-year intervals. Periodic inspections of the masonry walls at Ginna have not identified any significant degradation or cracking.

The NMP-1 LRA states that its Masonry Wall Program manages aging effects so that the evaluation basis established for each masonry wall within the scope of license renewal remains valid through the PEO. The Masonry Wall Program is based on the structures monitoring requirements of 10 CFR 50.65. The Masonry Wall Program is implemented by the Structures Monitoring Program for managing specific aging effects. The program requires periodic visual inspection of masonry walls in the scope of license renewal to detect loss of material and cracking of masonry units and mortar.

There are 150 safety-related masonry walls at NMP-1. Periodic visual inspections are scheduled not to exceed 6 years under controlled interior environment. The frequency of inspection of masonry is per the Structures Monitoring Program. There are 13 un-braced and non-reinforced safety-related masonry walls, which are scheduled for visual inspections every 4 years per the NMP-1 LR Commitment No. 39. This is consistent with the "Detection of Aging Effects" program element of GALL Report AMP XI.S5 that recommends frequent inspections of non-reinforced masonry walls. NMP-1 compares past inspection checklists to recent checklists for trending. In addition, the checklist results are compared to the evaluation basis developed for the respective masonry walls during the resolution of IEB 80-11.

Inspections in 2005 indicated that the masonry walls at NMP-1 are generally in good physical condition, with only a few areas of minor degradation. Deficiencies were evaluated and appropriate corrective actions were taken. The most recent quarterly Health Reports for the program (July–September 2011) rated it as "Acceptable" and "Green." The program appears to have no accessibility problems or repetitive observations.

2.4.6 XI.S6 Structures Monitoring

Ginna implements this program through its AMP B2.1.32, "Structures Monitoring Program," and NMP-1 through its existing AMP B2.1.28, "Structures Monitoring Program." Ginna's Structures Monitoring Program was developed and implemented to meet the regulatory requirements of the Maintenance Rule (10 CFR 50.65), RG 1.160, and NUMARC 93-01 for managing aging effects in structures. The program also includes management of aging effects of masonry walls, as mentioned above, and water-control structures in accordance with RG 1.127, "Inspection of Water-Control Structures Associated with Nuclear Power Plants." The program is consistent with the following AMPs in the GALL Report, Rev. 0: AMP XI.S5," Masonry Wall Program;" AMP XI.S6, "Structures Monitoring Program;" and AMP XI.S7, "RG 1.127, "Inspection of Water-Control Structures Associated with Nuclear Power Plants." Revision 1 and Revision 2 of the GALL Report are not used by Ginna.

Visual inspection of the structures, masonry walls, and water-control structures at Ginna is performed at a frequency of 5 years. Since the renewal license was issued, there have been no changes to the AMP implementing procedures with regard to OpE, response to NRC requirements or code changes, or through the 10 CFR 50.59 process.

Other observations at Ginna include:

- The PBD is not revised when implementing procedures are revised.
- The visual inspection acceptance criteria in the implementing procedure appear less rigorous than those specified in American Concrete Institute (ACI) 349.3R, which is cited in the GALL Report.
- There is no indication of stoppage or debris in the leak chase channels of the spent-fuel pool because there is continuous flow of water. The leakage rate had been approximately 400 gallons per day. Some repairs prior to the audit reduced the leakage to approximately 200 gallon per day. In addition, no indication of leakage has been found in the accessible outside surfaces of the spent-fuel pool. Excavation performed outside near the pool for constructing the spent-fuel dry cask storage system also did not find any indication of leakage.
- Reactor cavity leakage has occurred during refueling outages at a rate of approximately 3 to 10 gallons per minute. Attempts to repair the leak have been unsuccessful.
- Chemical analyses of the water collected from the leak collection channels is performed periodically for pH, iron, calcium and boron. Flow rate is measured once a week.
- No formal calculations or documentation was identified that documents or trends concrete or masonry wall degradation.

NMP-1's Structures Monitoring Program provides for periodic visual inspections, surveys, and examination of all safety-related buildings (including the primary containment and substructures within the primary containment) and various other buildings. The program identifies degradation of materials of construction, which include structural steel, concrete, masonry blocks, and sealing materials. While not credited for mitigation of aging, protective coatings are also inspected under this program. The program is consistent with GALL Report XI.S6, “Structures Monitoring Program,” with the following enhancements:

- Expand the parameters monitored to include those aging effects requiring management for structural bolting.
- Implement regularly scheduled groundwater monitoring to facilitate prompt identification if a benign environment is not being maintained.
- Expand the scope of the program to include the steel electrical transmission towers required for the station blackout event and recovery paths that are within the scope of license renewal.
- Expand the program to include fire rated assemblies and watertight penetration visual inspections.

The program provides for visual inspections and surveys, as well as examinations of all building and structures within the scope of license renewal, including surveys such as displacements of sliding surfaces and seismic gaps between buildings. This is consistent with IN 97-11 (Cement Erosion from Containment Subfoundations at Nuclear Power Plants) and IN 98-26 (Settlement Monitoring and Inspection of Plant Structures Affected by Degradation of Porous Concrete Subfoundations), and assures that inspections of structures include the examination interfaces between structures, when accessible, for indications of building settlement and/or differential settlement.

The details of the inspection intervals are described in the PBD. The interval depends upon the functions of the particular SSCs. For SSCs for which no degradation or defects were identified in the baseline inspection, the inspection interval is not to exceed 6 years/3 cycles. For SSCs with evidence of degradation requiring corrective actions or that may require future restoration, an appropriate monitoring frequency is established based on the function and degraded conditions of the SSCs. For degradation not requiring corrective actions, NMP-1 monitors the condition of the degraded areas during each refueling cycle for a period of at least three cycles.

Groundwater leakage at NMP-1 appears to be seasonal, with persistent groundwater leakage in one location. The NMP-1 OpE (SER Section 3.0.3.3.21) states that minor cracking is present in various concrete structures, and slight (but stable) groundwater leaks in some tunnels. Several CRs have confirmed minor cracking in concrete structures, including the service water pipe tunnel, allowing leakage of groundwater. Groundwater also has entered switchgear building, service water tunnels, and the radwaste building of below-grade exterior walls.

NMP-1 has nine wells for groundwater monitoring through routine sampling and analysis of groundwater conditions. The groundwater chemistry is sampled at least once every 6 months for indicators of corrosive environment. This frequency is much higher than that recommended in the GALL Report (every 5 years). Previous tests at NMP-1 indicate the presence of chlorides at greater than 500 ppm, sulfate greater than 1500 ppm, and pH less than 5.5 in some wells. The licensee stated that these aggressive groundwater conditions are localized. Since 2008, chlorides have been observed to be out of specification six times, and sulfate only once. These locations were close to site roads where road salt is used during the winter.

The program requires that, following an unusual event such as an earthquake, tornado, or flooding, an initial inspection should be conducted to assess the condition of the affected SSCs. A follow-on complete structural inspection may be required, depending on the assessment. This provision is not present in the GALL Report.

Other observations of potential AMP technical and implementation weakness and other general observations from the audit of NMP-1's Structures Monitoring Program include:

- The AMP implementing procedure has personnel qualification requirements that are different from those in ACI 349.3R, which is cited in all revisions of the GALL Report. During the interview, the licensee stated that the requirements are comparable.
- The licensee maintains and continuously updates the baseline data resulting from the inspections. The licensee stated that the inspectors review CRs for the two previous outages before walkdowns to identify any specific areas of concern.
- The structural monitoring walkdown checklist is not based on ACI 349.3R as recommended in the GALL Report, Rev. 2. It is site developed, and is based on the GALL Report, Rev. 0.
- The AMP implementing procedure states that submerged structures such as the intake tunnel are to be inspected, if possible. Previously, the licensee sent divers to inspect the tunnel, and minor cracking was identified. The licensee is considering using a small remotely operated submarine-type vehicle to inspect the tunnel in the future.
- The licensee inspects structural components such as cable trays and conduit supports using the sampling technique described in EPRI NP-7218. This approach has not been observed at other plants.
- No indications of fuel pool and reactor cavity leakage have been found.

2.4.7 XI.S7 RG 1.127 Inspection of Water-Control Structures Associated with Nuclear Power Plants

Ginna implements this program through AMP B2.1.32, "Structures Monitoring Program." Ginna water-control structures include the circulating water system discharge canal, the canal interface with the pump screen house, and a stone revetment that protects the site from storm surge flooding. No earthen water-control structures are used at Ginna. The Ginna LRA stated that large armor stones are used in the revetment, which underwent a site-specific review by the U.S. Army Corps of Engineers (Corps) in the review of Systematic Evaluation Program topics II-3.A, II-3.B, and II-3.C, "Hydrology, Flooding, and Ultimate Heat Sink." The Structures Monitoring Program and Periodic Surveillance and Preventive Maintenance program execute the recommendations made by the Corps by performing surveys and inspections of the armor stone and cap rocks to ensure that erosion and stone movement do not compromise the functionality of the water-control structure.

This program is not being used at NMP-1; instead, underwater inspections are performed as a repetitive task as part of the NMP-1 Periodic Surveillance and Preventive Maintenance Program. The Periodic Surveillance and Preventive Maintenance Program also inspects for silting and fouling of water-control structures. Divers and submarine-mounted cameras are used to inspect the underwater surfaces of the screen house, discharge canal, canal valves, and weir gates, and the intake tunnels and structure. Results of these inspections are reviewed by qualified engineers as part of the Structures Monitoring Program. Concrete used in water-control structures has been evaluated for the aging mechanisms of freeze-thaw, leaching of calcium hydroxide, reaction with aggregates, corrosion of embedded steel, aggressive chemical attack, settlement, and abrasion.

2.4.8 XI.S8 Protective Coating Monitoring and Maintenance Program

Ginna implements this program through AMP B2.1.24, "Protective Coatings Monitoring and Maintenance Program," and NMP-1 through AMP B2.1.38, "Protective Coating Monitoring and Maintenance Program". Ginna has done extensive work related to a generic safety issue (GSI) regarding the clogging of containment emergency sumps. In order to address GSI-191, Ginna developed the containment coatings condition assessment procedure, EP-3-P-0601, that allows analysis assumptions to be verified and ensures that design margin with respect to degraded and unqualified coatings is maintained. Ginna devoted significant effort to improving AMP Elements 3, (Parameters Monitored, Inspected, and/or Tested), 4 (Detection of Aging Effects), and 5 (Monitoring and Trending). By the end of 2008, Ginna had completed the installation of replacement sump strainers. The audit determined that there were 11 coatings-related CRs included in the Ginna LR CR Trending Documents. Numerous other cases of containment liner corrosion were discovered. The causes of these instances of corrosion included degraded coatings, degraded moisture barrier seals, or water accumulation from various sources such as condensation from the internal air condition on the liner surface. The inspection of coatings is performed at each refueling outage (every 18 months). The inspection conducted in 2009 indicated that the total amount of degraded containment coatings was 223 ft^2, or less than 25% of the total amount permitted to ensure post-accident operability of the emergency core-cooling system (ECCS) suction strainers.

The Ginna AMP owners suggested updating of GALL AMP XI.S8 to incorporate the guidance of ASTM D7230-06, Standard Guide for Evaluating Polymeric Lining Systems for Water Immersion in Coating Service Level III Safety-Related Applications on Metal Substrates, July 1, 2006. They also suggested the inclusion of both Service Level II and III coatings in the AMP. As stated in Revision 2 of RG 1.54, Service Level III coatings are used in areas outside the reactor containment where failure could adversely affect the safety function of a safety-related SSC. Following the audits at Ginna and NMP-1, NRC staff issued a draft LR-ISG (LR-ISG-2012-02) related to internal surfaces and corrosion under insulation that included a new AMP XI.M42, Service Level III and Other Coatings Monitoring and Maintenance Program.

The NMP-1's Protective Coating Monitoring and Maintenance Program is an existing program that applies to Service Level I protective coatings inside the primary containment and items within the torus (outside surface of the vent (ring) header and downcomer, inside surface of the vent piping, ring header, vent header junctions, and downcomers). The program has the following enhancements:

- Visual examination of coated surfaces for any visible defects including blistering, cracking, flaking, peeling, and physical or mechanical damage
- Inspection of coatings during every refueling outage
- Minimum qualifications for inspection personnel, inspection coordinators, and inspection results evaluators
- Thorough visual inspections in areas noted as deficient concurrently with general visual inspections
- Specification of the types of instruments and equipment that may be used for inspections.
- Reviews of the previous two monitoring reports before the condition assessment
- Guidelines for prioritization of repair areas to be monitored until they are repaired
- Inspection results evaluators to determine which areas are unacceptable and to initiate corrective action

As stated in the AMP PBD, once an area in containment with cracks, peeling, or delaminated coating has been detected, visual estimation will be used to quantify the surface area. Conservative estimates will be made using known structural dimensions to quantify the total amount of degraded coatings. The total amount of degraded coatings is then compared to the total amount of permitted degraded coatings to ensure post-accident operability of the ECCS suction strainers. Should the conservative estimate of degraded coatings exceed the permitted amount, more definitive measurements could be taken or coating repairs performed immediately. In the 2011 coatings inspection, it was found that the total amount of failed coating available for transport to the ECCS suction strainers was conservatively estimated at about 52.6 lb., which is below the allowed 85 lb. in design calculations. There have been no dramatic changes during the three previous outages.

2.4.9 X.S1 Concrete Containment Tendon Prestress

Ginna has a prestressed concrete containment. Ginna implements AMP B3.3, “Concrete Containment Tendon Prestress,” to manage its TLAAs related to containment tendon prestress. This program is not applicable to NMP-1, which has a steel containment. The Ginna program is consistent with AMP X.S1 of the GALL Report, Rev. 0. The acceptance criteria are consistent with the methodology of RG 1.35.1, and are based on a predicted lower limit prestressing force and the minimum required prestressing force, also called the minimum required value. The trending of prestressing forces follows the guidance of IN 99-10.

Ginna had two commitments in Appendix A of the SER related to this AMP:

(1) The initial re-tensioned set of 23 tendons was to be re-tensioned to ensure that prestressing forces remained above the minimum required value during the PEO (Commitment 6). This was completed in 2005, 4 years prior to entry into the PEO.

(2) Perform two structural integrity tests at design pressure during the PEO (Commitment 27). The first of these was completed during the 2011 refueling outage. The second will be performed in 2020 or 2021 (Commitment 27).

Ginna re-tensioned 23 of the 160 vertical tendons 1,000 h after initial prestressing. Subsequent tests determined that the tendon lift-off forces were generally lower than the predicted values. The investigation concluded that the accelerated loss of lift-off forces was caused by stress relaxation of the tendon wires. Tendon stress relaxation tests conducted at Lehigh University, in preparation for the installation of fiber optic strain gages on 20 of the 160 tendon locations, indicated that this stress relaxation over time was caused by the increase in temperature from ambient conditions to operating conditions.

In the license renewal SER (NUREG-1786), the NRC staff found that evaluation of the structural integrity test results would reveal if there is a gross change in the containment behavior, which would, in turn, indicate significant degradation of the inaccessible components in the containment. Other observations from the audit include:

- The Ginna containment is unique from a regular prestressed concrete containment. The vertical tendons are anchored at the base to rock anchors by bellows. In addition, there are neoprene pads embedded in the concrete at the base and spring line of containment. This unique design required some additional surveillance requirements for the prestressing tendons and containment pressure tests.
- The strain gauges that were installed at 20 of the 160 tendon locations to measure the tendon forces and possible loss of prestress were installed for research purposes. The

lift-off testing of 14 random tendons every 5 years that is required by the current AMP will continue.

2.4.10 NMP-1 Drywell Supplemental Inspection Program (Plant-Specific)

The “Drywell Supplemental Inspection Program” at NMP-1 is a plant-specific program that managed aging effects at six localized areas of the drywell shell that have suffered corrosion in the past. These six areas are located near and underneath the drywell coolers at the 225-ft elevation. The degradation was due to the use of chemicals for cleaning the coils of the drywell coolers, which was discontinued once the degradation was realized. This program provided aging management activities for the six localized areas, in addition to the activities required by the ASME Section XI ISI (Subsection IWE) Program.

To ensure that the aging effects of the drywell shell were managed in the PEO, the AMP relied on the following activities:

- Performed volumetric examinations on the drywell shell during the refueling outage in accordance with ASME IWE requirements and performed engineering evaluations to determine necessary actions.
- Established the acceptance criteria based on the calculated corrosion rate (mil/years), margin to design thickness (mils), and the projected wall thickness at the end of extended operation. Depending on observed (or calculated) corrosion rate, intervals between UT measurements may have ranged from 2 to 10 years.
- Monitored the shell thickness to ensure pressure boundary function was maintained through the PEO.

The program is consistent with AMP XI.S1 of the GALL Report, Rev. 2, and ASME Section XI Subsection IWE, which require augmented inspection if the loss in thickness is greater than 10 percent of the nominal wall thickness in local areas. However, the licensee found general corrosion of about 5 percent of the nominal thickness in six areas and determined that a special monitoring program was necessary to ensure that the reduced thickness is within the design requirements during the PEOs.

NMP-1 has a commitment (Commitment 42) in the license renewal SER (NUREG-1900) to perform volumetric examinations on the NMP-1 drywell shell during the 2007 refueling outage. An engineering evaluation would then be performed to determine the actions necessary for operation through the PEO, in accordance with the NMP-1 “Drywell Supplemental Inspection Program.” UT measurements were performed in 2007 and 2009 to establish a trend in the loss of thickness, which was virtually nil due to the containment being nitrogen-inerted during operation. After measurements, the six areas were cleaned and recoated with a two-part epoxy Carboline coating. This epoxy coating will be monitored by the Service Level I Coatings AMP and the drywell will continue to be inspected under the ASME Section XI IWE AMP (which has the same action requirements as the Drywell Supplemental Inspection Program); however, the plant-specific “Drywell Supplemental Inspection Program” has now been discontinued.

NMP-1 has established the detailed acceptance criteria based on the calculated corrosion rate (mil/years), margin to design thickness (mils), and the projected wall thickness at the end of extended operation. Depending on the calculated corrosion rate, UT measurements are performed at intervals ranging from 2 to 10 years.

2.4.11 NMP-1 Torus Corrosion Monitoring Program (Plant-Specific)

The Torus Corrosion Monitoring Program at NMP-1 is an existing plant-specific AMP used to obtain and analyze NMP-1 torus wall thickness data for use in establishing the torus shell material ongoing corrosion rate and shell wall thickness. The program includes torus UT measurements and torus coupon analysis. The program also provides for visual inspections of the external support structure of the torus. When NMP-1 torus corrosion was found in 1993, NMP submitted the “Torus Corrosion Monitoring Program,” which included a “Torus UT Measurement Program” and “Torus Coupon Analysis Program,” to the NRC for review and approval. The SER approving the overall “Torus Corrosion Monitoring Program” was issued in 1994; the program was an existing program credited for torus aging management in the LRA.

The LRA stated that torus wall UT measurements were obtained at approximately 6-month intervals over a predefined grid system, and corrosion sample coupons were analyzed during each refueling outage. The plant procedure CPR-N1-T-001, Rev. 4 (issued on February 10, 2006), incorporated the commitments of inspection frequency in the LRA. However, in Revision 5 of this document (issued on January 19, 2007, after issuance of the renewed license), the frequency of inspection was revised as follows:

- UT examination of selected areas from outside of torus frequency changed from 6 months to 1 year.
- Coupons retrieval from the water line in the torus frequency changed from 2 years to 6 years.

The licensee changed the inspection frequency commitment through its commitment evaluation process, consistent with the NRC-endorsed NEI 99-04 commitment change process. The licensee determined that the corrosion rate in the torus had been less than what was assumed in the SER and that adequate margin exists for the minimum required wall thickness of 0.431 in. The licensee basis for this change is that corrosion rate in August 1994 UT examination was 1.243 mils/year. This rate gradually decreased to 0.801 mils/year in 2004. In 2011, the corrosion rate was 0.313 mils/year. However, these corrosion rates do not agree with corrosion rates obtained from the coupons, which was found to be 0.462 mils/year at the last outage. The methodology for the determination of the loss rate from one RFO to the next and the projection for when the minimum Torus wall thickness will be reached is in accordance with the NRC-approved “Torus Corrosion Monitoring Program.”

In summary, NMP-1 has established the detailed acceptance criteria based on the calculated corrosion rate (mil/years), margin to design thickness (mils), and the projected wall thickness at the end of extended operation. However, the UT measurements are performed on the pre-selected areas with known thinnest average wall thickness.

2.5 AMPs for Electrical Systems

This section describes the AMPs related to electrical systems (also see Table A.5), including the AMPs numbered XI.E1 through XI.E6 in Chapter XI of the GALL Report, Rev. 2, and one AMP associated with management of TLAAs related to environmental qualification (X.E1 “Environmental Qualification (EQ) of Electric Components”). The program description of the AMPs summarizes the aging effects to be managed, the aging mechanism(s) responsible for these effects, the overall approach proposed to manage this aging effect, and the technical basis for this approach. In general, the program descriptions provided in the Ginna and NMP-1 AMPs for electrical systems, which were prepared under GALL Report, Rev. 0, guidance met the AMP objectives. Furthermore, the SRP-LR, Rev. 2, states that this program element should include the specific structures and components that are subject to an aging management review. The Ginna and NMP-1 AMPs generally satisfied this provision as well. Table A.5 illustrates the relationship between the electrical AMPs as reviewed during the Ginna and NMP-1 audits.

2.5.1 XI.E1 Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements

The objective of this AMP is to provide reasonable assurance that the intended function of electrical cables and connections that are not subject to the environmental qualification requirements of 10 CFR 50.49 and are exposed to adverse local environments caused by heat, radiation, or moisture will be maintained consistent with the current licensing basis through the PEO. As stated in the GALL Report, this is a condition-monitoring program and no actions are taken as part of this program to prevent or mitigate aging degradation.

The Ginna "Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements" program does not limit the program to adverse localized environments but is structured to identify any such areas that may exist in the plant spaces subject to an AMR. The applicant also clarified that, should a plant space not contain any significant stressors, a detailed inspection is not likely to occur but the plant space is not eliminated from future inspections. These future inspections would assess whether any changes in the space have occurred that could have added significant stressors or adverse localized environments to the space.

The Ginna license renewal aging management PBD provides a description of the program and activities associated with this program. The PBD implements the modifications noted by the staff license renewal SER, including not limiting the program to adverse localized environments. The PBD identifies the implementing procedures, establishes repetitive task frequencies, work orders and inspections to be performed.

The walk downs performed at Ginna consisted of non-intrusive visual inspection and temperature measurement (infrared) of accessible cables, with photographs taken as required. The walk downs included in-scope and out-of-scope components located in the identified locations. No significant changes were noted to the AMP with regard to operating experience, NRC requirements, or power uprate.

The inspections at Ginna identified four cases where debris was found on cable jackets. The cable jackets were noted to be in good condition. Analysis of the debris by the applicant concluded that material degradation was unlikely. The applicant also generated three CRs that identified suspect damaged cable jackets, and improper cable wrapping (tape). A review of trends in CRs from September 24, 2008, through March 31, 2011, listed the above corrective actions with no indication of increasing trends.

The NMP-1 LRA states that AMP B2.1.29, "Non-EQ Electrical Cables and Connections Program," is a new program that is consistent with GALL AMP XI.E1, "Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements." The program manages aging of cables and connectors that are within the scope of license renewal and are exposed to adverse localized environments (temperature, moisture, or radiation). The AMP uses visual inspection of in-scope accessible cable and connection jacket material for degradation due to identified adverse localized environments (temperature, moisture, or radiation). The applicant identified the development and implementation of this program as Commitment No. 27.

NMP-1 manages cable and connection aging by the identification of adverse localized environments and the use of visual inspections of in-scope accessible cable and connections jacket material to identify cable and connection jacket (insulation) degradation that may result in cable and connection loss of insulation resistance and loss of continuity. The results of the accessible cable and connections inspection are considered representative of the inaccessible cables and connections. Unacceptable conditions are evaluated and a determination is made as to whether the same condition is applicable to other accessible and inaccessible cables or connections.

The NMP-1 inspection identified adverse localized environments and three condition reports were initiated. No unanticipated or premature component degradation was noted in the inspection results. The implementing procedures and associated work orders did not identify unanticipated component degradation or inconclusive results.

2.5.2 XI.E2 Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits

The objective of this AMP is to provide reasonable assurance that the intended functions of electrical cables and connections (that are not subject to the environmental qualification requirements of 10 CFR 50.49 and are used in instrumentation circuits with sensitive, high-voltage, low-level current signals exposed to adverse localized environments caused by temperature, radiation, or moisture) are maintained consistent with the current licensing basis through the PEO. As stated in the GALL Report, this is a performance-monitoring program and no actions are taken as part of this program to prevent or mitigate aging degradation.

For Ginna, staff noted that the LRA described AMP B2.1.11 as a periodic visual inspection program, whereas GALL AMP XI.E2 is a program based on (1) calibration results or findings of surveillance testing programs, which are evaluated to identify the existence of cable and connection insulation material aging degradation, or (2) direct testing of the cable system. In response to an NRC request for additional information during the review of the LRA, the applicant concluded that visual inspection for mechanical aging defects for these circuits is appropriate, but also stated that they perform periodic insulation resistance testing on these circuits, which would continue into the PEO. The applicant ultimately implemented an AMP to perform insulation resistance testing in addition to visual inspections.

Ginna work orders reviewed indicated test performance anomalies but were not inconsistent with expected results. Three corrective actions were noted including a loose connector, disparity between detector readings, and display repair. Work orders were initiated and repetitive tasks established. The audit did not identify any adverse trends.

The NMP-1 LRA states that AMP B2.1.30, “Non-EQ Electrical Cables and Connections Used in Instrumentation Circuits Program,” is an existing program. The program manages the aging of cables exposed to adverse localized temperature, radiation, and moisture that could lead to a loss of insulation resistance. This program applies to accessible and inaccessible electrical cables used in circuits with sensitive, high voltage, low level signals (e.g., radiation monitoring, nuclear instrumentation) that are not part of the EQ program. The Non-EQ Electrical Cables and Connections Used in Instrumentation Circuits Program manage aging through calibration surveillances or by direct testing of the cable. The AMP reviews calibration results or findings of surveillance programs to provide an indication of the existence of aging effects based on acceptance criteria related to instrumentation circuit performance. Procedures were developed and existing procedures revised to identify credited sections for license renewal. Reviewing the results obtained during normal calibration or surveillances provides a means to detect aging degradation. Results for the 10 year period reviewed concluded that cable systems were in acceptable condition. Cable failures were stated to be due to moisture intrusion, connection makeup or connection contamination. The applicant stated that inspection of failure sites did not indicate breakdown of the insulation or jacket.

2.5.3 XI.E3 Inaccessible Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements

The objective of this AMP is to provide reasonable assurance that the intended functions of inaccessible or underground power cables that are not subject to the EQ requirements of 10 CFR 50.49 and are exposed to wetting or submergence are maintained consistent with the current licensing basis through the PEO. As stated in the GALL Report, AMP XI.E3 is a condition-monitoring program. However, periodic actions are taken to prevent inaccessible cables from being exposed to significant moisture, such as identifying and inspecting in-scope accessible cable conduit ends and cable manholes for water collection and draining the water, as needed.

The Ginna LRA identified four medium-voltage power cables installed in underground duct banks but determined that the failure of these cables would not prevent the satisfactory accomplishment of any intended function and concluded that there were no inaccessible medium voltage cables within the scope of license renewal. In its review of the Ginna LRA, the staff requested the applicant to identify electrical and I&C components, including medium voltage cables and connections, that were eliminated from aging management activities, and the basis for concluding that these components did not provide a license renewal intended function. The applicant response identified medium voltage cables eliminated from aging management. The staff agreed with the scoping for these medium-voltage cables but questioned the exclusion of additional cables from license renewal aging management. The applicant subsequently included the additional medium voltage cables in the scope of license renewal and provided a new aging management program.

The initial testing of in-scope cables medium-voltage cable at Ginna was completed with no issues noted. Ginna established repetitive tasks for the offsite power circuit underground duct banks that inspects and pumps out these manholes on a weekly basis. A condition report was also initiated to complete the scoping of medium voltage cables. Ginna identified six cables, including in-scope cables, as part of the revised medium voltage program. A new procedure was established for these cables. The program includes testing and inspection for water accumulation. In addition, Ginna initiated an action item to establish a low voltage cable program. An additional repetitive task for water accumulation was also established for low voltage cable subjected to submergence.

This AMP is not applicable for NMP-1 because there are no non-EQ inaccessible medium voltage cables within the scope of license renewal for Unit 1, as documented in procedure NER-1E-026. This program is applicable to NMP Unit 2. The SER for NMP-2 stated that the AMP was consistent with GALL AMP XI.E3.

Although GALL AMP XI.E3 in Revision 2 of the GALL Report expanded the scope of the AMP to include inaccessible low voltage power cables (>400 volts) and removed the “significant voltage” criterion (25% of the time), NMP-1 indicated that no additional cables are in-scope for this AMP. Procedure NER-1E026 screened cables based on medium voltage, and whether the cable is energized 25% of the time, and also identified additional cable as medium voltage cable rated but not energized by a medium voltage.

A review of GL 2007-01 and plant documentation for NMP states that there is no history of failure of inaccessible or underground cables within the scope of 10 CFR 50.65. The response does not differentiate between NMP-1 and NMP-2. The staff reviewed the applicant's barrier analysis of IN 2010-26 which informs licensees of protracted cable submergence in water, NRC inspection findings and responses to GL 2007-01. The barrier analysis discusses the implementation of low and medium voltage power cable management programs.

Subsequently, NMP-1 has initiated condition reports to implement a low voltage power cable aging management program. In addition, a procedure has been developed for low voltage cable and medium voltage cable. Although not directly tied to the increased scope of GALL AMP XI.E3 in Revision 2 of the GALL Report (e.g., adding low voltage power cable), the applicant has identified an increased scope of inaccessible power cable aging management by adding medium (three cables identified for NMP-1) and low voltage power cable based on plant specific and industry operating experience, industry guidance, and NRC communication (IN).

2.5.4 XI.E4 Metal-Enclosed Bus (Site-Specific)

The objective of this AMP is to provide an internal and external inspection of metal-enclosed buses (MEBs) to identify age-related degradation of insulating material (i.e., porcelain, xenoy, thermoplastic organic polymers) and metallic and elastomeric components (e.g., gaskets, boots, and sealants). As stated in the GALL Report, this program would be defined as a condition-monitoring program and no actions are taken as part of this program to prevent or mitigate aging degradation.

Since the GALL Report, Rev. 0, did not include AMP XI.E4, Ginna originally addressed the aging management of the in-scope electrical bus components as a one-time inspection. In response to staff questions and industry operating experience during review of the Ginna LRA, the applicant committed to include additional periodic joint resistance testing credited under the B2.1.23 Periodic Surveillance and Preventive Maintenance program (as shown in Table A.5).

The NMP-1 LRA identifies AMP B2.1.34, "Non-Segregated Bus Inspection Program," as an existing plant-specific program with enhancements. The AMP periodically inspects the material and components internal to in-scope non-segregated bus duct.

The applicant's program depends on internal inspection of MEBs to identify age related degradation of insulating material (i.e., porcelain, xenoy, thermoplastic organic polymers) and metallic and elastomeric components (e.g., gaskets, boots, and sealants). For Ginna, the implementing procedures and associated work orders noted acceptable inspection results with no unanticipated component degradation or inconclusive results noted. The inspection at NMP-1 was performed with satisfactory results with one CR generated for a loose bolt and incorrect use of washers on one connection.

2.5.5 XI.E5 Fuse Holders (Site-Specific)

The objective of this AMP is to provide reasonable assurance that the intended function of the metallic clamps of fuse holders are maintained consistent with the current licensing basis through the PEO. It manages fuse holders (metallic clamps) located outside of active devices that are considered susceptible to the following aging effects: increased resistance of connection due to chemical contamination, corrosion, and oxidation or fatigue caused by ohmic heating, thermal cycling, electrical transients, frequent manipulation, or vibration. Fuse holders inside an active device (e.g., switchgear, power supplies, power inverters, battery chargers, and circuit boards) are not within the scope of this AMP. As stated in the GALL Report, this program is defined as a condition-monitoring program and no actions are taken as part of this program to prevent or mitigate aging degradation. GALL AMP XI.E5, “Fuse Holders,” addresses the metallic portion of the fuse holder and the associated aging mechanisms and effects.

As discussed below for each plant, this AMP is not implemented at either Ginna or NMP-1.

Because GALL AMP XI.E5 was not included in Revision 0 of the GALL Report, this AMP was not addressed by the Ginna LRA. Based on staff questions concerning potential in-scope fuse holder aging mechanisms and effects during its review of the Ginna LRA, the applicant reviewed in-scope fuse holders and concluded that these fuse holders are not subject to the aging mechanisms or effects identified by the staff. The staff accepted the applicant’s evaluation in its SER.

The NMP-1 plant-specific fuse holder inspection program monitors fuse holder parameters, including high resistance of the fuse holder metallic clamp to detect fatigue caused by moisture, ohmic heating, mechanical stress, vibration, thermal cycling, electrical transients, chemical contamination, oxidation, and corrosion. The fuse holder inspection program tests the metallic portion of the fuse holder using thermography, contact resistance testing, or other appropriate testing methods. The inspections are performed every 10 years with the initial inspection performed prior to the PEO.

The NMP LRA scoped in fuse holders consistent with 10 CFR 54.4(a)(3). However, all 259 fuses identified as associated with systems within the scope of license renewal and not part of an active assembly screened out as not requiring aging management. This AMP was not implemented based on subsequent scoping and screening of in-scope fuse holders.

2.5.6 XI.E6 Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (Site-Specific)

The objective of this AMP is to provide reasonable assurance that the intended function of the metallic parts of electrical cable connections that are not subject to the environmental qualification requirements of 10 CFR 50.49 and susceptible to age-related degradation resulting in increased resistance of connection due to thermal cycling, ohmic heating, electrical transients, vibration, chemical contamination, corrosion, or oxidation are maintained consistent with the current licensing basis through the PEO. Cable connections associated with cables within the scope of license renewal that are external connections terminating at active or passive devices are in the scope of this AMP. Wiring connections internal to an active assembly are considered part of the active assembly and, therefore, are not within the scope of this AMP. This AMP does not include high-voltage (greater than 35 kilovolts) switchyard connections. The cable connections covered under the EQ program are not included in the scope of this program. This is a condition-monitoring program and no actions are taken as part of this program to prevent or mitigate aging degradation.

The GALL Report electrical connections program XI.E6 (metallic portion of the connection) and associated aging mechanisms were not addressed in the GALL Report, Rev. 0, and were not addressed by Ginna in its LRA (see Table A.5). The metallic portion of connections as a component is not addressed in GALL AMP XI.E1, which manages the insulated portion of cables and connectors. GALL Report Rev. 0 evaluated electrical connectors not subject to 10 CFR 50.49 EQ requirements that are exposed to borated water leakage. This program is not handled under a GALL Report electrical AMP but is addressed separately under the Ginna program that relates to GALL AMP XI.M10, “Boric Acid Corrosion.”

The NMP-1 LRA describes AMP B2.1.39, “Non-EQ Electrical Cable Metallic Connection Inspection Program,” as a new plant-specific program. The program addresses the aging effects of the metallic parts used to connect cable conductors to other cable or components. Connections include splices (butt of bolted connections), crimp type, and terminal blocks. The aging stressors associated with these connectors and addressed by this program include: thermal cycling, ohmic heating, electrical transients, electrical transients, vibration, chemical contamination, corrosion, and oxidation. This AMP was included in the NMP LRA due to development of AMP XI.E6, “Electrical cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements,” in Revision 1 of the GALL Report.

The audit identified no changes to this AMP based on operating experience. All testing met the acceptance criteria with no findings or corrective actions initiated. AMP implementation did not find aging effects for the sample connections selected.

2.5.7 X.E1 Environmental Qualification of Electrical Components

An EQ program manages thermal, radiation and cyclical aging for electrical equipment. For license renewal, plant EQ programs that implement the requirements of 10 CFR 50.49 are considered AMPs that are used to provide aging management during the PEO for TLAAs associated with EQ in accordance with 10 CFR 54.21(c)(1)(iii). The aging reanalysis in the EQ program considered important attributes including the analytical method, data collection and reduction methods, the underlying assumptions, acceptance criteria, and corrective actions. If the qualification of a component cannot be extended, that component is subject to corrective action (e.g., refurbished, replaced, or re-qualified) prior to exceeding the current qualification term (qualified life).

The Ginna “Environmental Qualification Program” is established for compliance with 10 CFR Part 50, Appendix A, Criterion 4, and 10 CFR 50.49, and is an existing AMP. The EQ program manages component thermal, radiation, and cyclical aging based on 10 CFR 50.49(f). The Ginna EQ AMP describes the aging management associated with environmentally qualified electrical equipment within the scope of license renewal. This program is considered a TLAA for license renewal. The TLAA is applicable for EQ components with a qualified life of greater than 40 years. The applicant performed a confirmatory analysis to verify existing analyses were adequate for the PEO. The PBD described activities related to the Ginna EPU project, noting that the environmental conditions were recalculated for normal and accident conditions. The engineering report evaluating EQ for the extended uprate project was provided during the audit. EQ equipment, including equipment identified as a TLAA for license renewal, were evaluated based on the extended power uprate environmental conditions. The Ginna Procedure EP-3-P-0139 established and implemented the license renewal commitment while LRTA-01 summarizes the evaluation of EQ electrical equipment for extended operation.

The NMP-1 “Environmental Qualification Program” is an existing program that is consistent with GALL Report AMP X.E1, “Environmental Qualification (EQ) of Electric Components.” The EQ program demonstrates that certain electrical components located in harsh environments (subject to the harsh environmental effects of a LOCA, high-energy line breaks, or post-LOCA environment) are qualified to perform their safety function when subjected to a harsh environment after the effects of in-service aging. The effects of significant aging mechanisms are addressed as part of EQ, including the replacement or refurbishment components not qualified for the license term prior to the end of designated life. Qualification may also be extended prior to reaching the components qualified life. Aging evaluations for EQ components that specify a qualified life of at least 40 years are considered TLAAs for license renewal. Procedure revisions were implemented for the re-evaluation of a components qualified life from 40 to 60 years.

SECTION 3

SUMMARY

The NRC has completed "AMP Effectiveness Audits" at two operating nuclear power plants (NPPs), the Robert Emmett Ginna (Ginna) and Nine Mile Point Unit 1 (NMP-1) plants. These "AMP Effectiveness Audits" are designed to provide an understanding of how AMPs have been implemented by NPPs during the period of extended operation (PEO) and the degradation that has been identified by the aging management programs (AMPs). This audit activity is being conducted to assist the development of guidance documents for the technical review of applications for subsequent license renewal (SLR), i.e., that would authorize plant operation beyond 60 years. The results from these audits provide key information to aid the NRC in identifying needed changes to existing AMPs and new AMPs that may be needed to provide assurance of safe plant operation during an SLR operating period.

The scope of these AMP Effectiveness Audits addressed:

- Understanding how the AMPs have been implemented by licensees during the PEO (e.g., the types of component inspections that have been conducted and any access impediments for the inspections)

- Reviewing the findings from the AMPs in terms of the types of degradation that have been identified

- Identifying how the AMPs have changed based on plant-specific and industry operating experience

This report provides the staff's detailed observations from the AMP audits at Ginna and NMP-1 on an AMP-specific basis. Results from these audits and future AMP audits involving a larger number of NPPs would be used to derive generic conclusions.

The results from these audits have been used to refine the approach for future AMP Effectiveness Audits, to widen the knowledge base and enable broader conclusions to be drawn to support the development of guidance documents for SLR. Once sufficient information has been gathered, the information will be evaluated to inform:

- Aging effects that need to be managed during an SLR operating period

- Changes to existing license renewal AMPs to improve the performance of the AMPs for management of aging effects during the SLR operating period

- New AMPs that need to be added for the SLR operating period

The following program strengths and good practices were identified from detailed AMP-wise observations provided in the AMP discussion sections:

- Periodic assessments such as program health reports and focused self-assessments can contribute to a basis for determining when the implementation of an AMP may need adjustment.

- A robust process for review of plant-specific and industry-wide operating experience related to aging management findings, and implementation of the findings from such reviews, can ensure that the AMPs have the proper scope and focus to effectively manage aging.

SECTION 4

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APPENDIX

Table A.1 Key Points of Contact during Ginna Audit

NRC Staff on Audit	**Argonne Support**	**Licensee Personnel**
Bennett Brady	Omesh Chopra	Scott Baylor
Cliff Doutt	Dwight Diercks	Michael Canny
Jim Gavula	Yogen Garud	Brian Dahl
Allen Hiser	David Ma	Michael Fallin
Amy Hull		Rod Fett
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		George Herrick
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Jim Medoff		John Sperr
Glenn Meyer		Walter Tono
Kenn Miller		Jay Wells
Greg Oberson		A. Guillermo
Aloysius Obodoako		Ben Johns
Emma Wong		B. Weaver
Matt Yoder		K. Connor
		M. Bodine

Table A.2 Summary of Ginna AMPs and Corresponding GALL AMPs

GINNA AMP (see NUREG-1786 section)	GALL Report
Aboveground Carbon Steel Tanks (B2.1.1)	XI.M29
ASME Section XI, Subsections IWE and IWL Inservice Inspect (B2.1.3)	XI.S1, XI.S2, XI.S4
ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection (B2.1.2)	XI.M1
ASME Section XI, Subsection IWF, Inservice Inspection (B2.1.4)	XI.S3
Bolting Integrity (B2.1.5)	XI.M18
Boric Acid Corrosion (B2.1.6)	XI.M10
Buried Piping and Tanks (B2.1.7) and (B2.1.8)	XI.M28, XI.M34, XI.M41
Closed-Cycle (Component) Cooling Water System (B2.1.9)	XI.M21
Compressed Air Monitoring (B2.1.10)	XI.M24
Concrete Containment Tendon Pre-stress (B3.3)	X.S1
Electrical Cables and Connections Not Subject to EQ (B2.1.11)	XI.E1, XI.E6
Electric Cables Not Subject to EQ Used in Instrumentation Circuits (B2.1.12)	XI.E2
Environmental Qualification Program (B3.1)	X.E1
Fatigue Monitoring (B3.2)	X.M1
Fire Protection (B2.1.13)	XI.M26
Fire Water System (B2.1.14)	XI.M27
Flow-Accelerated Corrosion (B2.1.15)	XI.M17
Fuel Oil Chemistry (B2.1.16)	XI.M30
Heavy & Light Load (Related to Refueling) Handling Syst (B2.1.18)	XI.M23
Inaccessible Medium-Voltage Cables Not Subject to EQ (B2.1.17)	XI.E3
Loose Parts Monitoring (B2.1.19)	XI.M14
Neutron Noise Monitoring (B2.1.20)	XI.M15
One-Time Inspection (B2.1.21)	XI.M32
Open-Cycle Cooling (Service) Water (B2.1.22)	XI.M20
Periodic Surveillance and Preventive Maintenance (B2.1.23)	Plant specific XI.M38; XI.M39
Protective Coatings Monitoring and Maintenance Program (B2.1.24)	XI.S8
Reactor Head Closure Studs (B2.1.25)	XI.M3
Reactor Vessel Head Penetration Inspection (B2.1.26)	XI.M11
Reactor Vessel Internals (B2.1.27)	XI.M16A
Reactor Vessel Surveillance (B1.1.28)	XI.M31
Selective Leaching of Materials (B2.1.29)	XI.M33
Spent Fuel Pool Neutron Absorbing Monitoring (B2.1.30)	XI.M22
Steam Generator Tube Integrity (B2.1.31)	XI.M19
Structures Monitoring Program (B2.1.32)	XI.S5, XI.S6, XI.S7
System Monitoring (B2.1.33)	Plant specific, XI.M36
Thermal Aging Embrittlement of CASS (B2.1.34)	XI.M12
Thimble Tube Inspection Program (B2.1.36)	Plant specific
Water Chemistry Control (B2.1.37)	XI.M2

Table A.3 Key Points of Contact during NMP-1 Audit

NRC Staff on Audit

Bennett Brady
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Pat Finnerty
Steve Homoki
Scott Houston
George Inch
Phil Kehoe
Jeff Park
Tim Roche
Bob Saunderson
Brian Shanahan
Jeff Stevenson
Bill Sullivan
Jim Wadsworth
Cheryl Widay-Poindexter
Clark Willett

Table A.4 Summary of NMP-1 AMPs and Corresponding GALL AMPs

NMP 1 AMP (see NUREG-1900 SER)	GALL Report
10 CFR 50 Appendix J (B2.1.23, B2.1.26)	XI.S4
ASME Section XI, IWB, C, D (B2.1.1)	XI.M1
ASME Section XI, IWE (B2.1.23)	XI.S1
ASME Section XI, IWF (B2.1.25)	XI.S3
Bolting Integrity (B2.1.36)	XI.M18
Boraflex Monitoring (B2.1.12)	XI.M22
Buried Piping and Tanks Inspection (B2.1.28)	XI.M28
BWR Feedwater Nozzle (B2.1.5)	X1.M5
BWR Penetrations (B2.1.7)	XI.M8
BWR Reactor Water Cleanup (B2.1.15)	XI.M25
BWR Rod Control Drive Return Line Nozzle (B2.1.37)	XI.M6
BWR SCC (B2.1.6)	XI.M7
BWR Vessel ID Attachment Welds (B2.1.4)	XI.M4
BWRVIP (B2.1.8)	XI.M9
Closed-Cycle Cooling Water System (B2.1.101	XI.M21
Compressed Air Monitoring (B2.1.14)	XI.M24
Drywell Supplemental Inspection	Plant-specific
Environmental Qualification	X.E1
Fatigue Monitoring	X.M1
Fire Protection (B2.1.16)	XI.M26
Fire Water System (B2.1.17)	XI.M27
Flow-Accelerated Corrosion (B2.1.9)	XI.M17
Fuel Oil Chemistry (B2.1.18)	XI.M30
Inspection of Overhead Heavy Load and Light Load Handling Systems (B2.1.13)	XI.M23
Masonry Wall (B2.1.27)	XI.S5
Non-EQ Electrical Cable Metallic Connections/ fuse holder inspect prog. (B2.1.35, 2.1.39)	XI.E5, XI.E6
Non-EQ Electrical Cables and Connections	XI.E1
Non-EQ Electrical Cables and Connections used in Instrumentation Circuits (B2.1.30)	XI.E2
Non-Segregated Bus Inspection (B2.1.34)	XI.E4
One-Time Inspection (B2.1.20)	XI.M35, XI.M32
Open-Cycle Cooling Water System (B2.1.10)	XI.M20
Preventive Maintenance	Plant-specific
Protective Coating Monitoring and Maintenance (B2.1.38)	XI.S8
Reactor Head Closure Studs (B2.1.3)	XI.M3
Reactor Vessel Surveillance (B2.1.19)	XI.M31
Selective Leaching (B2.1.21)	XI.M33
Structures Monitoring (B2.1.28)	XI.S5, XI.S6, XI.S7
Systems Walkdown	Plant-specific
Torus Corrosion Monitoring	Plant-specific
Water Chemistry Control (B2.1.2)	XI.M2

Table A.5 Relationship between GALL AMPs and those implemented at the audited plants

GALL AMP ID	GALL AMP	Ginna (WEST 2LP PWR) NUREG-1786 AMP Reviewed	NMP-1 (Mark-I BWR) NUREG-1900 AMP Reviewed
AMPS for Mechanical Systems			
X.M1	Fatigue Monitoring (TLAA)	Fatigue Monitoring (B3.2)	Fatigue Monitoring
XI.M1	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD	ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection (B2.1.2)	ASME Section XI Inservice Inspection (IWB,IWC, IWD) (B2.1.1)
XI.M2	Water Chemistry	Water Chemistry Control (B2.1.37)	Water Chemistry Control (B2.1.2)
XI.M3	Reactor Head Closure Stud Bolting	Reactor Head Closure Studs (B2.1.25)	Reactor Head Closure Studs Program (B2.1.3)
XI.M4	BWR Vessel ID Attachment Welds	*N/A — AMP exclusively for BWRs*	BWR Vessel ID Attachment Welds Program (B2.1.4)
XI.M5	BWR Feedwater Nozzle	*N/A — AMP exclusively for BWRs*	BWR Feedwater Nozzle Program (B2.1.5)
XI.M6	BWR Control Rod Drive Return Line Nozzle	*N/A — AMP exclusively for BWRs*	BWR Rod Control Drive Return Line Nozzle Program (B2.1.37)
XI.M7	BWR Stress Corrosion Cracking	*N/A — AMP exclusively for BWRs*	BWR Stress Corrosion Cracking Program (B2.1.6)
XI.M8	BWR Penetrations	*N/A — AMP exclusively for BWRs*	BWR Penetrations Program (B2.1.7)
XI.M9	BWR Vessel Internals	*N/A — AMP exclusively for BWRs*	BWR Vessels Internals Program (B2.1.8)
XI.M10	Boric Acid Corrosion	Boric Acid Corrosion (B2.1.6)	*N/A — AMP exclusively for PWRs*
XI.M11B	Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components (PWR Only)	Reactor Vessel Head Penetration Inspection (B2.1.26)	*N/A — AMP exclusively for PWRs*
XI.M12	Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)	Thermal Aging Embrittlement of CASS (B2.1.34)	*N/A — no CASS piping at NMP-1*
XI.M13	Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS) – *retired after GALL Rev. 1.*	*N/A — see AMP XI.M12*	*N/A — see AMP XI.M12*
XI.M14	Loose Part Monitoring – *retired after GALL Rev. 1.*	Loose Parts Monitoring (B2.1.19)	*N/A — AMP not implemented at NMP-1*
XI.M15	Neutron Noise Monitoring – *retired after GALL Rev. 1.*	Neutron Noise Monitoring (B2.1.20)	*N/A — AMP exclusively for PWRs*

Table A.5 Relationship between GALL AMPs and those implemented at the audited plants

GALL AMP ID	GALL AMP	Ginna (WEST 2LP PWR) NUREG-1786 AMP Reviewed	NMP-1 (Mark-I BWR) NUREG-1900 AMP Reviewed
XI.M16A	PWR Vessel Internals	Reactor Vessel Internals (B2.1.27)	*N/A — AMP exclusively for PWRs*
XI.M17	Flow-Accelerated Corrosion	Flow-Accelerated Corrosion (B2.1.15)	Flow-Accelerated Corrosion Program (B2.1.9)
XI.M18	Bolting Integrity	Bolting Integrity (B2.1.5)	Bolting Integrity Program (B2.1.36)
XI.M19	Steam Generators	Steam Generator Tube Integrity (B2.1.31)	*N/A — AMP exclusively for PWRs*
XI.M20	Open Cycle Cooling Water System	Open-Cycle Cooling (Service) Water (B2.1.22)	Open Cycle Cooling Water System Program. (B2.1.10)
XI.M21A	Closed Treated Water System	Closed-Cycle (Component) Cooling Water System (B2.1.9)	Closed-Cycle Cooling Water System Program (B2.1.11)
XI.M22	Boraflex Monitoring	*N/A — see AMP XI.M40*	Boraflex Monitoring Program (B2.1.12)
XI.M23	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems	Heavy & Light Load (Related to Refueling) Handling Syst (B2.1.18)	Inspection of Overhead Heavy Load and Light Load Handling Systems Program (B2.1.13)
XI.M24	Compressed Air Monitoring	Compressed Air Monitoring (B2.1.10) (also see AMP B2.1.33)	Compressed Air Monitoring Program (B2.1.14)
XI.M25	BWR Reactor Water Cleanup System	*N/A — AMP exclusively for BWRs*	BWR Reactor Water Cleanup (RWCU) System Program (B2.1.15)
XI.M26	Fire Protection	Fire Protection (B2.1.13)	Fire Protection Program (B2.1.16)
XI.M27	Fire Water System	Fire Water System (B2.1.14)	Fire Water System Program (B2.1.17)
XI.M28	Buried Piping and Tanks Surveillance – *retired after GALL Rev. 1.*	*N/A — see AMP XI.M41*	*N/A — see AMP XI.M41*
XI.M29	Above Ground Metallic Tanks	Aboveground Carbon Steel Tanks (B2.1.1)	*N/A — AMP not implemented at NMP-1 which credits plant-specific Preventive Maintenance Program (B2.1.32) and Systems Walkdown Program (B2.1.33)*
XI.M30	Fuel Oil Chemistry	Fuel Oil Chemistry (B2.1.16)	Fuel Oil Chemistry Program (B2.1.18)
XI.M31	Reactor Vessel Surveillance	Reactor Vessel Surveillance (B2.1.28)	Reactor Vessel Surveillance Program (B1.1.19)
XI.M32	One-Time Inspection	One-Time Inspection (B2.1.21)	One-Time Inspection Program (B2.1.20)
XI.M33	Selective Leaching	Selective Leaching of Materials (B2.1.29)	Selective Leaching Program (B2.1.21)
XI.M34	Buried Piping and Tanks Inspection – *retired after GALL Rev. 1.*	*N/A — see AMP XI.M41*	*N/A — see AMP XI.M41*

Table A.5 Relationship between GALL AMPs and those implemented at the audited plants

GALL AMP ID	GALL AMP	Ginna (WEST 2LP PWR) NUREG-1786 AMP Reviewed	NMP-1 (Mark-I BWR) NUREG-1900 AMP Reviewed
XI.M35	One-time Inspection of ASME Code Class 1 Small Bore-Piping – *first introduced in GALL Rev. 1.*	*N/A — No audit — LRA prepared under GALL Rev. 0*	*N/A — No audit — LRA prepared under GALL Rev. 0*
XI.M36	External Surfaces Monitoring of Mechanical Components – *first introduced in GALL Rev. 1.*	*N/A — LRA prepared under GALL Rev. 0 & credits plant-specific System Monitoring program (B2.1.33)*	*N/A — LRA prepared under GALL Rev. 0 & credits plant-specific Systems Walkdown Program (B2.1.33)*
XI.M37	Flux Thimble Tube Inspection – *first introduced in GALL Rev. 1.*	*N/A — LRA prepared under GALL Rev. 0 & credits plant-specific Thimble Tube Inspection Program (B2.1.36)*	*N/A — AMP exclusively for PWRs*
XI.M38	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components – *first introduced in GALL Rev. 1.*	*N/A — LRA prepared under GALL Rev. 0 & credits plant-specific Periodic Surveillance and Preventive Maintenance program (B2.1.23)*	*N/A — LRA prepared under GALL Rev. 0 & credits plant-specific Preventive Maintenance Program (B2.1.32)*
XI.M39	Lubricating Oil Analysis – *first introduced in GALL Rev. 1.*	*N/A — No audit — LRA prepared under GALL Rev. 0 & credits plant-specific Periodic Surveillance and Preventive Maintenance program (B2.1.23)*	*N/A — No audit*
XI.M40	Monitoring of Neutron Absorbing Materials Other than Boraflex – *first introduced in GALL Rev. 2.*	Spent Fuel Pool Neutron Absorber Monitoring (B2.1.30)	N/A — *see AMP XI.M22*
XI.M41	Buried and Underground Piping and Tanks – *first introduced in GALL Rev. 2.*	Buried Piping and Tanks Inspection (B2.1.7) Buried Piping and Tanks Surveillance (B2.1.8)	Buried Piping and Tanks Surveillance (B2.1.28)
AMPS for Structural Systems			
X.S1 (TLAA)	Concrete Containment Tendon Prestress	Concrete Containment Tendon Pre-stress (B3.3)	N/A — *NMP-1 has steel containment*
XI.S1	ASME Section XI, Subsection IWE	ASME Section XI, Subsections IWE and IWL Inservice Inspection (B2.1.3) *(combining XI.S1, XI.S2, and XI.S4)*	ASME Section XI Inservice Inspection (Subsection IWE) Program (B2.1.23)
XI.S2	ASME Section XI, Subsection IWL	ASME Section XI, Subsections IWE and IWL Inservice Inspection (B2.1.3) *(combining XI.S1, XI.S2, and XI.S4)*	*N/A — AMP not implemented at NMP-1, only at NMP-2*
XI.S3	ASME Section XI, Subsection IWF	ASME Section XI, Subsections IWF Inservice Inspection (B2.1.4)	ASME Section XI Inservice Inspection (Subsection IWF) Program (B2.1.25)
XI.S4	10 CFR 50, Appendix J	ASME Section XI, Subsections IWE and IWL Inservice Inspection (B2.1.3) *(combining XI.S1, XI.S2, and XI.S4)*	10 CFR 50 Appendix J Program (B2.1.26)
XI.S5	Masonry Walls	Structures Monitoring (B2.1.32) *(combining XI.S5, XI.S6, and XI.S7)*	Masonry Wall Program (B2.1.27)

Table A.5 Relationship between GALL AMPs and those implemented at the audited plants

GALL AMP ID	GALL AMP	Ginna (WEST 2LP PWR) NUREG-1786 AMP Reviewed	NMP-1 (Mark-I BWR) NUREG-1900 AMP Reviewed
XI.S6	Structures Monitoring	Structures Monitoring (B2.1.32) *(combining XI.S5, XI.S6, and XI.S7)*	Structures Monitoring Program (B2.1.28)
XI.S7	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	Structures Monitoring (B2.1.32) *(combining XI.S5, XI.S6, and XI.S7)*	N/A — *auditor reviewed NMP-1 plant-specific Periodic Surveillance and Preventive Maintenance Program*
XI.S8	Protective Coating Monitoring and Maintenance Program	Protective Coatings Monitoring and Maintenance Program (B2.1.24)	Protective Coating Monitoring and Maintenance Program (B2.1.38)
---	*No GALL counterpart to plant-specific program (related AMR line-item II.B1.2.CP-63 credits XI.S1 and XI.S4 and possible additional plant-specific activities)*	*N/A — plant-specific AMP not discussed at Ginna*	Drywell Supplemental Inspection *(specific to NMP-1)*
---	*No GALL counterpart to plant-specific program (related AMR line-item II.B1.1.CP-48 credits XI.S1 and XI.S4 and possible additional plant-specific activities)*	*N/A — plant-specific AMP not discussed at Ginna*	Torus Corrosion Monitoring *(specific to NMP-1)*
AMPS for Electrical Systems			
X.E1 (TLAA)	Environmental Qualification of Electrical Equipment	Environmental Qualification (B3.1)	Environmental Qualification
XI.E1	Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements	Electrical Cables and Connections Not Subject to EQ (B2.1.11)	Non-EQ Electrical Cables and Connections
XI.E2	Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits	Electric Cables Not Subject to EQ Used in Instrumentation Circuits (B2.1.12)	Non-EQ Electrical Cables and Connections used in Instrumentation Circuits (B2.1.30)
XI.E3	Inaccessible Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements	Inaccessible Medium-Voltage Cables Not Subject to EQ (B2.1.17)	*N/A — AMP not implemented at NMP-1, only at NMP-2*
XI.E4	Metal-Enclosed Bus – *first introduced in GALL Rev. 1*	*N/A — LRA prepared under GALL Rev. 0 & credits site-specific Periodic Surveillance and Preventive Maintenance program (B2.1.23)*	Non-Segregated Bus Inspection *(B2.1.34 site-specific)*
XI.E5	Fuse Holders – *first introduced in GALL Rev. 1.*	*N/A — LRA prepared under GALL Rev. 0 , no counterpart site-specific AMP*	Non-EQ Electrical Cable Metallic Connections/ fuse holder inspection program *(B2.1.35 site-specific)*
XI.E6	Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements – *first introduced in GALL Rev. 1.*	Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (B2.1.11)	Non-EQ Electrical Cable Metallic Connections/ fuse holder inspection program *(B2.1.39 site-specific)*