BGE Calvert Cliffs Nuclear Power Plant

License Renewal Project

Aging Management Review Report

for

Component Supports

Revision 2

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Prepared by: B.M. Tilden Date: 5/21/96

Reviewed by: D.J. DiBello Date: 5/21/96

Approved by: B. W. Doroshuk Date: 5/21/96

COMPONENT SUPPORTS AGING MANAGEMENT REVIEW REPORT
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SUMMARY OF CHANGES

Revision Number	Reason for Change
0	Initial Issue.
1	Incorporate minor BGE editorial comments related to Revision 0.
2	Incorporate snubber supports into the Component Supports Aging Management Review and clarify the handling of instrument tubing clips per the resolution to TPR 96-015. Update the status of SVP walkdown inspections of tank ring foundations per the resolution of TPR 96-023. Correct several terminology inconsistencies.

EXECUTIVE SUMMARY

The Component Supports Aging Management Review Report documents the methodology for, and justification of, the commodity approach used to review and evaluate the aging management of the CCNPP component supports included in systems that have been determined to be within the scope of license renewal (WSLR). This report comprises the Individual Plant Assessment (IPA) for component supports required for CCNPP's license renewal effort.

The approach to the commodity evaluation of component supports relies heavily on two existing site activities related to structural supports: the Seismic Verification Project (SVP) and the ASME Section XI In-Service Inspection (ISI) Program. Since the SVP is a one-time occurrence, and the ISI inspection of specific component supports occurs at 10-year intervals, the commodity approach for component supports also relies on the ongoing site activities for managing aging (e.g., general walkdowns by system engineers).

The commodity evaluation of component supports includes the following steps:

- Grouping of component supports into types, and evaluation of Age-Related Degradation Mechanisms (ARDMs) associated with each component support type.
- Identification of WSLR systems containing each component support type, and determination of coverage by the SVP and the ISI Programs.
- Description of the SVP and ISI Programs with respect to component supports and justification that these programs and the other site follow-on programs are adequate to manage the effects of component support aging.
- Development of evaluation recommendations for component support types that are not fully covered by the existing CCNPP programs.

The commodity approach to grouping of component supports and evaluation of ARDMs led to a matrix of 20 component support types and 11 applicable ARDMs. BGE has identified 66 WSLR systems, and 42 of them have component supports with the scope of this report. Another matrix was prepared to show the relationship between the 20 component support types and the 42 WSLR systems within the scope of this report. This matrix also shows the extent of coverage by the SVP and ISI programs for these component support types. The technical bases of the SVP and ISI programs were reviewed to establish the degree to which they could be relied upon for

aging management of component supports. The results of this review and the matrices were used to develop evaluation recommendations for aging management of component supports. Three types of recommendations are made:

- No additional action required–in this case the component support type coverage by SVP and ISI is considered sufficient for the IPA baseline. Only the ongoing actions, including the System Engineer walkdowns, ISI in some cases, Surveilance Inspections in some cases and Vibration Monitoring in some cases are required for aging management for License Renewal. The following component support types fall into this recommendation:

P-1-A	Piping Hangers/Supports Outside Containment (snubber supports only)
P-1-B	Piping Hangers/Supports Inside Containment (snubber supports only)
P-2-A	Piping Frames Outside Containment
C-1-A	Cable Raceway Supports Outside Containment
C-1-B	Cable Raceway Supports Inside Containment
H-1-A	HVAC Ducting Supports Outside Containment
E-1	Equipment with Elastomer Isolators Outside Containment
E-3	Equipment with Insulation in the Anchorage Load Path
E-4-A	Equipment Frames for Instruments on Racks and Batteries on Racks Outside Containment
E-5-A	Frames & Saddles for Tanks and Heat Exchangers Outside Containment
E-5-B	Frames & Saddles for Tanks and Heat Exchangers Inside Containment
E-6-A	Equipment Metal Spring Isolators & Fixed Bases for Pumps, Fans, Air handlers, Chillers, Air Compressors, M-G Sets, and EDGs Outside Containment
E-6-B	Same as E-6-A except Inside Containment
E-7	Equipment LOCA Restraints for Pressurizer and Reactor Coolant Pumps
E-8	Equipment Ring Foundations for Flat-bottomed Vertical Tanks Outside Containment

- Baseline walkdown recommended for "exception" component supports–in this case the vast majority of the supports within a component support type are considered to meet the IPA baseline even though the ISI or SVP scope only includes a portion of the component supports within the component support type. Extending the results of the

partial ISI and SVP coverage to the entire population is generally justified because the component supports are similar and their environment and potential ARDMs are the same. However, if there are a few component supports that are judged to be sufficiently different from the rest of the component support types, extrapolation is not justified, and additional baseline walkdowns are recommended. This situation applies to the following component support type:

E-2-A	Electrical Cabinet Anchorage for MCCs, SWGR, Distribution Panels, Control Panels Outside Containment

- Sampling baseline walkdown of the component supports recommended for some WSLR systems–in this case the component support types were not covered, or only partially covered by SVP and ISI, and there are exceptions within the component support type that prevent extrapolating the ISI and SVP results to the rest of the component supports. This situation applies to the following component support types:

P-1-A	Piping Hangers/Supports Outside Containment (except snubber supports)
P-1-B	Piping Hangers/Supports Inside Containment (except snubber supports)
P-2-B	Piping Frames Inside Containment
H-1-B	HVAC Ducting Supports Inside Containment
E-2-B	Equipment Electrical Cabinet Anchorage for MCCs, S[illegible], Distribution Panels, Control Panels Inside Containment
E-4-B	Equipment Frames for Instruments on Racks Inside Conta[illegible]ment

Note that, except for piping hangers/supports outside containment (P-1-A), all of these component support types are inside containment and not easily accessible. The recommendations in Table 6-1 for sampling walkdown inspections of P-1-A component supports are provided on a system, rather than a component support type basis. Piping hangers/supports did not lend themselves as well to the commodity approach. Specifically, the potential ARDMs of loading due to hydraulic vibration or thermal expansion are active for some systems (generally high energy systems), but not for other systems (generally "cold" systems).

One additional general recommendation for ongoing aging management of component supports is to make the the SVP walkdown packages available to the appropriate System Engineers. These packages include field notes and photographs that would facilitate assessments of future component support as-found conditions. CCNPP plans to image all SVP packages and make them available via the NUCLEIS/NORMs database system.

Section 1

INTRODUCTION

10 CFR Part 54 requires that nuclear power plant licensees who request renewal of their operating licenses for an additional 20 years of operation (i.e., for a total operating life of 60 years) perform an Integrated Plant Assessment (IPA) on all systems, structures, and components (SSCs) that are determined to be within the scope of license renewal (WSLR). The IPA must demonstrate that the effects of age-related degradation are being managed to ensure that the intended functions of these SSCs are maintained during the period of extended operation.

The Life Cycle Management (LCM) Unit at BGE is responsible for the IPA at CCNPP, and has completed the IPA review for plant structures (buildings) including walls, floors, equipment foundations, and anchor bolts. The structural supports which connect system components to plant structures were not included in this IPA review. The LCM Unit concluded that these structural supports could be handled more efficiently using a commodity approach since component supports perform basically the same function regardless of the system with which they are associated.

The purpose of this report, therefore, is to document the methodology and justification of the commodity approach used to review and evaluate the aging management of the CCNPP component supports included in WSLR systems. Specifically, this report (1) identifies types of component supports, (2) reviews the age-related degradation mechanisms (ARDMs) associated with these component support types, (3) evaluates the adequacy and scope of CCNPP programs that manage the effects of aging of these component support types, and (4) provides conclusions and recommendations.

The approach to the commodity evaluation of component supports relies heavily on two existing site activities related to structural supports: the Seismic Verification Project (SVP), and the piping support inspections required by the ASME Section XI In-Service Inspection (ISI) Program. The principal intent of the SVP is to verify the seismic adequacy of mechanical and electrical equipment, including equipment supports and anchorage, using the Seismic Qualification Utility Group (SQUG) methodology. The walkdown checklists used in the SVP require evaluations of equipment anchorage and support load path, including assessments of the as-found condition of concrete and other structural elements that might lessen the seismic adequacy of the equipment's support. The ISI Program includes visual examination of component supports of Class 1, 2, and 3 piping and pressure boundary components. The visual examination procedure requires that component supports be checked for the effects of age-related degradation. The ISI component support inspections are conducted at 10-year intervals

throughout the life of the plant. ISI of snubber supports is supplemented by a surveillance which inspects snubbers including their supports at more frequent intervals.

Since the SVP is a one-time occurrence, and the ISI inspection of a particular component support occurs at multi-year intervals, the commodity approach for component supports also relies on the ongoing site activities for managing aging of component supports, including general walkdowns by system engineers required by site guidelines. The QL-2-100 (Issue Reporting and Corrective Action) process requires these individuals to formally document any discrepancy they observe in the plant, including any material condition of structural supports which is questionable.

1.1 SCOPE OF COMPONENT SUPPORTS COMMODITY EVALUATION

1.1.1 Description of Component Supports Within the Scope of License Renewal

For the purposes of this report, "component support" is defined as the connection between a system, or component within a system, and a plant structural member, e.g., concrete floor or wall, structural steel beam or column, or the ground outside the plant buildings. Supports for both the distributive portion of systems, e.g., piping or cable raceways, and the system's equipment items are included in the scope of this report. The connections for line-mounted equipment (like valves in piping or temperature sensors in ducts) and for components attached directly to the pressure boundary of other plant components are not included in the scope of this report because they are not directly attached to a plant structural member.

In accordance with the current revision of 10 CFR Part 54.21, the scope of this report includes passive, long-lived component supports such as pipe hangers and anchor bolts. Since snubbers are active components, they are not within the scope of this report. However, the hardware components which mount the snubber to the piping and to the building are referred to as snubber supports and are included in the categories P-1-A and P-1-B. The snubber support includes hardware from the wall and piping/equipment to the snubber pin connections. Supports (clips) for tubing are included in the Instrument Line Commodity Evaluation and therefore are not within the scope of this report.

The CCNPP systems that are Within the Scope of License Renewal have been identified by BGE in Reference 1.1. Of the 66 WSLR systems identified in Reference 1.1, 42 include component supports within the scope of this report. These systems are discussed in Section 3.

1.1.2 Intended Functions

10 CFR Part 54.21(a)(3) requires that for SSCs identified as within the scope of license renewal "the effects of aging will be adequately managed so that the intended function(s) will be

maintained consistent with the current licensing basis (CLB) for the period of extended operation." For component supports, their intended function is to provide structural support for:

1. Systems and components required to remain functional during and following design basis events to ensure the integrity of the reactor coolant pressure boundary, the capability to shutdown the reactor and maintain it in a safe shutdown condition, and the capability to prevent or mitigate the consequences of accidents which could result in potential off-site exposures comparable to the 10 CFR Part 100 guidelines. or

2. Systems and components whose failure could prevent satisfactory accomplishment of safety functions for items identified in Part 1 above, and

3. Systems and components which are required for fire protection (10 CFR 50.48), environmental qualification (10 CFR 50.49), pressurized thermal shock (10 CFR 50.61), anticipated transients without scram (10 CFR 50.62) and station blackout (10 CFR 50.63), and the component is credited in the plant specific analysis for the events in the CCNPP CLB.

The intended function of system component supports is the same, regardless of the system. Therefore, a commodity evaluation methodology is appropriate for component supports.

1.2 EVALUATION METHODOLOGY

The commodity evaluation methodology includes the following steps:

1. Grouping of Component Supports into Types, and Evaluation of Age-Related Degradation Mechanisms Associated with Each Component Support Type-- Component supports are grouped based on their physical characteristics, environmental conditions (locations), and loading conditions. The 20 component support types identified by this review, and the basis for their selection, is presented in Section 2.

   The potential age-related degradation mechanisms (ARDMs) associated with each of the 20 component support types are also presented in Section 2. These ARDMs were identified based on a review of industry documents on aging mechanisms related to component supports. The information from the literature review was supplemented by materials engineering experience. Documents used in this report (references) are presented in Section 7, and a listing of all documents reviewed (bibliography) appears in Appendix B.

2. Identification of WSLR Systems Containing Each Component Support Type, and Determination of Coverage by Existing CCNPP In-Service Inspection (ISI) and Seismic Verification Project (SVP) Programs--The component support types identified in Section 2 are matched with WSLR systems in Section 3. Table 3-1 shows the extent of coverage by either the CCNPP ISI or SVP Programs for each system listed under each component type. A cross-reference of WSLR systems and the component support types contained in each system is provided in Table 3-2.

3. Description of the SVP Program with Respect to Component Supports and Justification that SVP and Follow-On Activities are Adequate to Manage the Effects of Component Support Aging--The Seismic Verification Project (SVP) was established at CCNPP to resolve the NRC's Unresolved Safety Issue A-46 on the seismic adequacy of older nuclear power plants. The SVP is using the NRC-approved Generic Implementation Procedure (GIP) (Reference 4.1) to verify the seismic adequacy of mechanical and electrical equipment required for safe shutdown following a seismic event. The seismic adequacy of electrical cable raceways (trays and conduit) is also evaluated using GIP criteria. The visual inspections (walkdowns), evaluations, and documentation of component support condition performed during the SVP are discussed further in Section 4 of this report. Section 4 also contains a discussion to justify the use of SVP and follow-on activities to manage the effects of component support age-related degradation. The SVP justification takes into account the age of the equipment in the 19 strong-motion earthquakes at over 80 industrial facilities on which the GIP is based. A list of the facilities and their approximate age at the time of the earthquake is presented in Appendix A.

4. Description of the ISI Program with Respect to Component Supports and Justification that ISI is Adequate to Manage the Effects of Component Support Aging--CCNPP maintains an ASME Section XI In-Service Inspection (ISI) program. A description of the ISI program scope and the justification for its use as an aging management program for component supports is provided in Section 5 of this report.

5. Evaluation Recommendations for Component Support Types that are Not Fully Covered by Existing CCNPP Programs--The results of the evaluation of aging management coverage by the SVP and ISI programs for WSLR system component supports is summarized in Section 6. The process used for determining recommended actions for each component support type is shown in Figure 6.1.

The recommended actions for each component support type and the basis for each recommendation are presented in Table 6-1.

Section 2

DESCRIPTION OF THE EFFECTS OF AGING ON COMPONENT SUPPORTS

2.1 TYPES OF SUPPORTS INCLUDED IN REVIEW

As described in Section 1, a commodity approach is used for aging management of component supports. This approach is possible for component supports for the following reasons:

- Although the systems within the scope of license renewal are diverse in function and physical appearance, component supports are more standard; for example, spring hangers in the service water system and the main steam system serve the same function and appear physically similar.
- Component supports in diverse systems but subject to the same environment and loading conditions will degrade in a similar fashion.

In the commodity approach, component supports which are physically similar, and which are subject to the same age-related degradation mechanisms (similar environment and loading conditions), are addressed as a group, regardless of the system they are in. Component support "types" are therefore selected based on similarity in form and degradation mechanisms.

For the purpose of selecting component support types, the component supports are grouped into four categories by the items they support: piping, cable raceways, HVAC ducting, and equipment.

Within each category, component support types are identified based on similarity of form and degradation mechanisms. For the category of piping, four separate component support types are used: hangers outside containment ("P-1-A"), hangers inside containment ("P-1-B"), piping frames outside containment ("P-2-A"), and piping frames inside containment ("P-1-B"). The "hangers" group of supports includes spring hangers, constant load supports, sway struts, rod hangers and snubber supports.[1]

The four types listed above are selected because:

- The environment inside containment is more severe than that outside containment (higher humidity, temperatures and radiation levels).

[1] Group P-1-B actually contains several snubber supports for equipment (steam generators and reactor coolant pump motors) since these supports are identical to snubber supports for piping.

- Hangers and snubber supports contain threaded fasteners in the load path which are directly loaded by thermal expansion (except snubber supports) and vibration induced loads, potentially resulting in fatigue damage or loosening of threaded joints. Piping frames are less likely to be degraded by vibration and thermal expansion.

For the next two categories, cable raceways and HVAC ducting, component support types are divided into those outside containment, and those inside containment. Although the potential age-related degradation mechanisms are the same for cable raceway supports outside containment ("C-1-A") and HVAC ducting supports outside containment ("H-1-A") (as is also the case for these categories inside containment, "C-1-B" and "H-1-B"), these component support types are not merged because their coverage by existing CCNPP programs is different.

Component support types in the equipment category are divided into eight main types, four of which are subdivided into outside containment ("A") and inside containment ("B") types. The bases for the selection of eight main equipment support types are the similarities in the supports/anchorage for the 20 classes of equipment used in the NRC-approved SQUG methodology for resolving USI A-46 (see Reference 4.1). SQUG equipment classes correspond to component support types as follows:

- E-1--Anchorage Including Elastomer Vibration Isolators--applies to SQUG classes 9 (fans), 10 (air handlers), 11 (chillers), and 12 (air compressors).
- E-2-A and E-2-B--Electrical Cabinet Anchorage--applies to SQUG classes 1 (MCCs), 2 & 3 (switchgear), 14 (distribution panels), and 20 (control panels).
- E-3--Electrical Equipment That May Include Insulation Material in Anchorage Load Path--applies to SQUG classes 4 (transformers), and 16 (battery chargers & inverters).
- E-4-A and E-4-B-- Frames for Instruments/Batteries--applies to SQUG classes 15 (batteries on racks), and 18 (instruments on racks).
- E-5-A and E-5-B-- Frames & Saddles--applies to SQUG class 21 (tanks and heat exchangers).
- E-6-A and E-6-B--Metal Spring Isolators & Fixed Bases--applies to SQUG classes 5 & 6 (pumps), 9 (fans), 10 (air handlers), 11 (chillers), 12 (air compressors), 13 (motor-generators), and 17 (engine generators).
- E-7--LOCA Restraints--applies to pressurizer and reactor coolant pump supports, which are outside the scope of USI A-46 and SQUG.

- E-8--Ring Foundations for Flat-Bottom Vertical Tanks--applies to a subclass of SQUG class 21 (tanks and heat exchangers).

SQUG classes 7 & 8 (valves), and class 19 (temperature sensors) are not included in the above list because they do not have "component supports" as defined in Section 1 of this report. That is, valves and temperature sensors are not normally mounted directly to plant structural members.

A total of 20 different component support types were identified in this manner. These component support types are listed in Table 2-1.

2.2 AGING EFFECTS ON INTENDED FUNCTION

Table 2-1 also lists the potential age-related degradation mechanisms (ARDMs) judged to apply to component supports. These mechanisms were selected based on a review of literature, and experience with component supports at other nuclear and fossil-fired power plants. In some cases, a particular ARDM only applies to some but not all of the component support types. In these cases, an "NA" is entered into Table 2-1 at the location in the table corresponding to the non-applicable ARDM and component support type.

For each of the potential ARDMs, Table 2-1 contains a determination whether the ARDM would affect the ability of the component support type to perform its intended function under all design conditions required by the CLB. If it is determined that the ARDM would not effect the component support type in such a manner, "not plausible" is entered into the appropriate location in the table and the justification for this determination is contained in a note to the table. For those ARDMs determined to be plausible or for which a determination could not be made based on available data, "Yes" is entered in the corresponding location in Table 2-1, indicating aging management is needed for the effects of this ARDM on the component support type. Any necessary explanation or clarification is again provided via notes to the table.

A brief discussion of the potential ARDMs is provided below.

2.2.1 <u>General Corrosion of Steel</u>

Uncoated carbon steel components will corrode in moist environments. In addition, EPRI NP-5769 (Reference 2.1) reports that leaking borated water has caused corrosion in pressure boundary bolts and studs made from low alloy steel (although no instances were reported involving borated water corrosion of component support bolting). Even though generally the component supports are coated at CCNPP, system engineers report occasional instances when support parts have been found corroded. Actions taken at CCNPP to manage corrosion include painting, housekeeping, and repair.

2.2.2 Stress Corrosion Cracking (SCC) of High Strength Bolts

EPRI NP-5769 (Reference 2.1) reports industry experience with SCC of component support bolts. In general, SCC-induced bolt failures occurred in studs and bolts greater than one inch in diameter in primary system applications. These applications included reactor coolant pump and steam generator support embedment anchor studs, pipe whip restraint connection bolts, and pipe whip restraint embedment anchor bolts. Failures generally occurred in high strength or overly hard materials installed in humid environments and subjected to high sustained tensile stresses. Failures were associated with two classes of steels: low-alloy quenched and tempered steels, and high nickel alloy and maraging steels. Most failures were found during plant construction. Despite these occurrences of individual bolt failures, no instances of overall component support joint failure were reported. The report concludes that "generic resolution of potential support and embedded bolting concerns by individual utilities is not warranted unless failures are experienced. Utilities that have bolting materials with specified yield strength greater than 150 ksi may wish to review their individual applications."

2.2.3 Elastomer Hardening

Elastomer materials are used in the anchorage load paths of some rotating machines to reduce the vibration transmitted to the supporting structures. Additionally, the anchorage load path for transformer coils typically contains electrical insulating material consisting of elastomers, or material similar to elastomers that degrades over time. Extended exposure to light, heat, oxygen, ozone, water or radiation can cause chain scission or cross linking of the polymer chains forming the elastomer materials (References 2.2 and 2.3). Chain scission (the breaking of chemical bonds) lowers the elastomer tensile strength and elastic modulus. Cross linking (undesirable linking of adjacent polymer strings at susceptible sites) makes the elastomer more brittle and promotes surface cracking.

2.2.4 Radiation Embrittlement of Steel

Exposure to accumulated neutron fluence greater than 6×10^{17} n/m^2 may cause steels to become brittle. Below this level, test programs have seen only a small effect on ductility and tension test properties (Reference 2.4). No supports in the scope of this review are subject to fluences above this limit. Therefore, this degradation mechanism is not applicable to the supports included in the scope of this report.

2.2.5 Thermal Effects on Steel

Carbon steels exposed to temperatures above 650°F and 800°F may degrade due to thermal embrittlement and creep respectively (Reference 2.9). Table 1-1 of the CCNPP UFSAR

(Reference 2.5) states that nominal operating steam temperature is about 525°F, and the nominal maximum reactor coolant temperature is about 600°F. Therefore, degradation of steel due to high temperature is not applicable for CCNPP component supports within the scope of this report.

2.2.6 Grout/Concrete Local Deterioration

Degradation of grout and concrete around anchorages or support locations due to environmental factors has not been cited as a concern for nuclear power plants.

2.2.7 Loading Due to Rotating/Reciprocating Machinery

Industry experience is that vibration problems with rotating/reciprocating machinery have sometimes been attributed to degradation of concrete foundations or anchorage.

2.2.8 Loading Due to Hydraulic Vibration or Thermal Expansion

Industry experience indicates that cyclic loads may cause threaded fasteners--especially poorly designed or incorrectly installed fasteners--to become loose (Reference 2.6). Also, radial cracking has been observed at tank anchor bolt locations for large vertical tank concrete ring foundations.

Industry experience with heat exchangers and tanks which see significant differential temperatures or significant hydraulic loadings, e.g., flow-induced vibration, flashing flow, or steam bubble collapse, is that age-related degradation of component supports sometimes occurs. This degradation can be observed if support features designed to accommodate these loadings, e.g., sliding surfaces, do not function properly, e.g., stick.

2.2.9 Other (Abuse, Impacts, Accidents)

Literature and industry experience provide examples of component support degradation by abuse, impacts, or accidents. These events potentially cause immediate damage in which case they are not considered ARDMs. However, these events may also initiate gradual degradation in which case the initiating event is an ARDM. This gradual degradation is defined as "error-induced aging degradation" by the NRC-approved Nuclear Power Plant Aging Terminology (Reference 2.7). The root cause of failures from error-induced aging degradation is human error, not aging. However, the control of error-induced aging degradation is part of aging management.

2.2.10 Lead Anchor Creep

Anchors made from lead are susceptible to creep over time, even at room temperatures. The current CCNPP design standard for piping and pipe supports (DS-040) (Reference 2.8) does not allow the use of lead anchors. Discussions with personnel involved in equipment installation at CCNPP concluded that cinch (lead) anchors may have been used to attach some light weight, non-safety electrical equipment items to block walls. Such items are not likely to be WSLR. Additionally, since wall-mounted equipment puts a dead load on anchors, lead relaxation, if there are any lead anchors, would become obvious.

Table 2-1
Potential Age-Related Degradation Mechanisms Associated with Component Support Types

Category	Component Support Type Number	Component Support Type	Potential Age-Related Degradation Mechanisms										
			Environment Dependent						Loading Dependent				Other
			General Corrosion of Steel	Stress Corrosion Cracking of High Strength Bolts	Elastomer Hardening	Radiation Embrittlement of Steel	Thermal Effects on Steel	Grout/ Concrete Local Deterioration	Loading Due to Rotating/ Reciprocating Machinery	Loading Due to Hydraulic Vibration or Water Hammer	Loading Due to Thermal Exp of Piping/ Component	Other (Abuse, Impacts, Accidents)	Lead Anchor Creep
Piping	P-1-A	Spring Hangers, Constant Load Supports, Sway Struts, Rod Hangers, Snubber Supports/ Outside Containment	Yes (Note 1)	Not Plausible (Note 2)	N/A	N/A	Not Plausible (Note 3)	Not Plausible (Note 4)	N/A	Yes	Yes (Note 13)	Yes	Not Plausible (Note 5)
Piping	P-1-B	Spring Hangers, Constant Load Supports, Sway Struts, Rod Hangers, Snubber Supports/ Inside Containment	Yes (Note 1)	Yes (Note 6)	N/A	Not Plausible (Note 7)	Not Plausible (Note 3)	Not Plausible (Note 4)	N/A	Yes	Yes (Note 13)	Not Plausible (Note 8)	Not Plausible (Note 5)
Piping	P-2-A	Piping Frames/ Outside Containment	Yes (Note 1)	Not Plausible (Note 2)	N/A	N/A	Not Plausible (Note 3)	Not Plausible (Note 4)	N/A	Not Plausible (Note 9)	Not Plausible (Note 10)	Yes	Not Plausible (Note 5)
Piping	P-2-B	Piping Frames Inside Containment	Yes (Note 1)	Yes (Note 6)	N/A	Not Plausible (Note 7)	Not Plausible (Note 3)	Not Plausible (Note 4)	N/A	Not Plausible (Note 9)	Not Plausible (Note 10)	Not Plausible (Note 8)	Not Plausible (Note 5)

Table 2-1 (Continued)
Potential Age-Related Degradation Mechanisms Associated with Component Support Types

Category		Component Support Type Number	Component Support Type	Potential Age-Related Degradation Mechanisms										
				Environment Dependent						Loading Dependent				Other
				General Corrosion of Steel	Stress Corrosion Cracking of High Strength Bolts	Elastomer Hardening	Radiation Embrittlement of Steel	Thermal Effects on Steel	Grout/ Concrete Local Deterioration	Loading Due to Rotating/ Reciprocating Machinery	Loading Due to Hydraulic Vibration or Water Hammer	Loading Due to Thermal Exp of Piping/ Component	Other (Abuse, Impacts, Accidents)	Lead Anchor Creep
Cable	Raceways	C-1-A	Channel, Clamp & Other Supporting Styles/ Outside Containment	Yes (Note 1)	Not Plausible (Note 2)	N/A	N/A	Not Plausible (Note 3)	Not Plausible (Note 4)	N/A	N/A	N/A	Yes	Not Plausible (Note 5)
Cable	Raceways	C-1-B	Channel, Clamp & Other Supporting Styles/ Inside Containment	Yes (Note 1)	Yes (Note 6)	N/A	Not Plausible (Note 7)	Not Plausible (Note 3)	Not Plausible (Note 4)	N/A	N/A	N/A	Not Plausible (Note 8)	Not Plausible (Note 5)
HVAC	Ducting	H-1-A	Rod Hanger, Trapeze Supports/ Outside Containment	Yes (Note 1)	Not Plausible (Note 2)	N/A	N/A	Not Plausible (Note 3)	Not Plausible (Note 4)	N/A	N/A	N/A	Yes	Not Plausible (Note 5)
HVAC	Ducting	H-1-B	Rod Hanger, Trapeze Supports/ Inside Containment	Yes (Note 1)	Yes (Note 6)	N/A	Not Plausible (Note 7)	Not Plausible (Note 3)	Not Plausible (Note 4)	N/A	N/A	N/A	Not Plausible (Note 8)	Not Plausible (Note 5)
Equipment		E-1	Anchorage Including Elastomer Vibration Isolators (for Fans, Compressors, Chillers, & Air Handlers)/	Yes (Note 1)	Not Plausible (Note 2)	Yes (Note 11)	N/A	Not Plausible (Note 3)	Not Plausible (Note 4)	Not Plausible (Note 12)	N/A	N/A	Yes	Not Plausible (Note 5)
Equipment		E-2-A	Electrical Cabinet Anchorage (MCCs, SWGR, Distribution Panels, Control Panels)/ Outside Containment	Yes (Notes 1 & 14)	Not Plausible (Note 2)	N/A	N/A	Not Plausible (Note 3)	Not Plausible (Note 4)	N/A	N/A	N/A	Yes	Not Plausible (Note 5)

Table 2-1 (Continued)
Potential Age-Related Degradation Mechanisms Associated with Component Support Types

Category	Component Support Type Number	Component Support Type	Potential Age-Related Degradation Mechanisms										
			Environment Dependent						Loading Dependent				Other
			General Corrosion of Steel	Stress Corrosion Cracking of High Strength Bolts	Elastomer Hardening	Radiation Embrittlement of Steel	Thermal Effects on Steel	Grout/ Concrete Local Deterioration	Loading Due to Rotating/ Reciprocating Machinery	Loading Due to Hydraulic Vibration or Water Hammer	Loading Due to Thermal Exp of Piping/ Component	Other (Abuse, Impacts, Accidents)	Lead Anchor Creep
Equipment	E-2-B	Electrical Cabinet Anchorage (MCCs, SWGR, Distribution Panels, Control Panels)/ Inside Containment	Yes (Notes 1 & 14)	Yes (Note 6)	N/A	Not Plausible (Note 7)	Not Plausible (Note 3)	Not Plausible (Note 4)	N/A	N/A	N/A	Not Plausible (Note 8)	Not Plausible (Note 5)
	E-3	Electrical Equipment That May Include Insulation Material in Anchorage Load Path (Transformers, Battery Chargers, Inverters)/ Outside Containment	Yes (Note 1)	Not Plausible (Note 2)	Yes (Note 15)	N/A	Not Plausible (Note 3)	Not Plausible (Note 4)	N/A	N/A	N/A	Yes	Not Plausible (Note 5)
	E-4-A	Equipment Frames (Instr. on Racks & Batteries on Racks)/ Outside Containment	Yes (Note 1)	Not Plausible (Note 2)	N/A	N/A	Not Plausible (Note 3)	Not Plausible (Note 4)	N/A	N/A	N/A	Yes	Not Plausible (Note 5)
	E-4-B	Equipment Frames (Instr. on Racks on Racks)/ Inside Containment	Yes (Note 1)	Yes (Note 6)	N/A	Not Plausible (Note 7)	Not Plausible (Note 3)	Not Plausible (Note 4)	N/A	N/A	N/A	Not Plausible (Note 8)	Not Plausible (Note 5)
	E-5-A	Frames, & Saddles (Tanks & HXs)/ Outside Containment	Yes (Note 1)	Not Plausible (Note 2)	N/A	N/A	Not Plausible (Note 3)	Not Plausible (Note 4)	N/A	Yes	Yes	Yes	Not Plausible (Note 5)

Table 2-1 (Continued)
Potential Age-Related Degradation Mechanisms Associated with Component Support Types

Category	Component Support Type Number	Component Support Type	Potential Age-Related Degradation Mechanisms: Environment Dependent: General Corrosion of Steel	Stress Corrosion Cracking of High Strength Bolts	Elastomer Hardening	Radiation Embrittlement of Steel	Thermal Effects on Steel	Grout/ Concrete Local Deterioration	Loading Dependent: Loading Due to Rotating/ Reciprocating Machinery	Loading Due to Hydraulic Vibration or Water Hammer	Loading Due to Thermal Exp of Piping/ Component	Other (Abuse, Impacts, Accidents)	Other: Lead Anchor Creep
Equipment	E-5-B	Frames & Saddles (Tanks & HXs)/ Inside Containment	Yes (Note 1)	Yes (Note 6)	N/A	Not Plausible (Note 7)	Not Plausible (Note 3)	Not Plausible (Note 4)	N/A	Yes	Yes	Not Plausible (Note 8)	Not Plausible (Note 5)
	E-6-A	Metal Spring Isolators & Fixed Bases (Pumps, Fans, Air Handlers, Chillers, Air Compressors, M-G Sets, EDGs)/ Outside Containment	Yes (Notes 1 & 16)	Not Plausible (Note 2)	N/A	N/A	Not Plausible (Note 3)	Not Plausible (Note 4)	Yes	N/A	N/A	Yes	Not Plausible (Note 5)
	E-6-B	Metal Spring Isolators & Fixed Bases (Pumps, Fans, Air Handlers, Chillers, Air Compressors, M-G Sets, EDGs)/ Inside Containment	Yes (Notes 1 & 16)	Yes (Note 6)	N/A	Not Plausible (Note 7)	Not Plausible (Note 3)	Not Plausible (Note 4)	Yes	N/A	N/A	Not Plausible (Note 8)	Not Plausible (Note 5)
	E-7	LOCA Restraints (PZR & RC Pump)/ Inside Containment	Yes (Note 1)	Yes (Note 6)	N/A	Not Plausible (Note 7)	Not Plausible (Note 3)	Not Plausible (Note 4)	Yes	Yes	Not Plausible (Note 17)	Not Plausible (Note 8)	Not Plausible (Note 5)
	E-8	Ring Foundation for Flat-bottom Vertical Tanks/ Outside	Yes (Note 18)	Not Plausible (Note 2)	N/A	N/A	Not Plausible (Note 3)	Not Plausible (Note 4)	N/A	N/A	Yes (Note 19)	Yes	Not Plausible (Note 5)

Table 2-1 (Continued)
Potential Age-Related Degradation Mechanisms Associated with Component Support Types

Notes:

1. All carbon steel components are subject to corrosion due to normal humidity levels in the plant. Corrosion degradation is prevented by providing and maintaining protective coatings, e.g., paint. Note that supports anchored to building floors could be subjected to standing water; however, this would be an abnormal condition, would be identified by routine operations walkdown, and would be corrected in a timely manner. The length of time that these components could be subject to such conditions, therefore, would be minimized.

2. High strength anchor bolts, i.e., those with yield strengths greater than 150 ksi, are susceptible to stress corrosion cracking (SCC) in a humid environment. High strength anchor bolts were not used intentionally at CCNPP, but there is a possibility that some high strength bolts could have been installed because bolt maximum strength limits were typically not specified for plants of CCNPP's vintage. (CCNPP Design Standard DS-040, Section 5.3 (Reference 2.8), lists standard anchor bolts types that have been used to attach pipe supports and other equipment at CCNPP.) Based on experience at other nuclear plants, when high strength bolts are used in a humid environment, early failures are expected in a matter of months. Widespread use of high strength bolts at CCNPP would have been detected during routine and programmatic inspections, including IE 79-02, ISI and SVP. (Reference 2.1) SCC is not, therefore, a plausible ARDM outside of containment.

3. The minimum temperature for age-dependent, thermal degradation mechanisms for carbon steel metals used in power plant applications is approximately 800°F for creep and 650°F for thermal embrittlement (Reference 2.9). Per the CCNPP UFSAR, the nominal maximum reactor coolant temperature is about 600°F. Therefore, this mechanism is not plausible for CCNPP component supports.

4. Industry experience has shown that supports anchored in concrete that experience static or limited dynamic loading are not subject to grout or local concrete deterioration from environmental factors alone. Deterioration of grout and localized concrete from loading stressors is considered separately under other ARDMs (Loading due to rotating/reciprocating machinery, hydraulic vibration/water hammer and thermal expansion).

5. Lead anchors degrade (creep at room temperature) over time. The current CCNPP design standard for piping and pipe supports (DS-040) does not allow the use of lead anchors. Discussions with personnel involved in equipment installation at CCNPP concluded that cinch (lead) anchors may have been used to attach some light weight, non-safety electrical equipment items to block walls. Such items are not likely to be WSLR. Additionally, since wall-mounted equipment puts a dead load on anchors, lead relaxation, if there are any lead anchors, would become obvious. This mechanism, therefore, is not plausible at CCNPP.

6. High strength anchor bolts (with yield strengths over 150 ksi) are potentially subject to stress corrosion cracking (SCC) in very damp environments with chloride. Industry experience has shown that concrete embedded anchor bolting has been susceptible to SCC, especially in containments. It is considered highly unlikely that high strength anchor bolting was installed in containment at CCNPP. Interviews with personnel involved with construction activities stated that no such bolting would have been installed based on good practices employed during construction. Based on industry experience, if such bolting had been installed, it would have failed early in plant life and been discovered during activities such as ISI inspections and SVP walkdowns. However, without a definitive procurement specification precluding installation of such bolting, this ARDM is not currently designated as not plausible for the more aggressive in-containment environment.

7. Based on recent industry reports (see Reference 2.4), significant radiation (neutron) embrittlement degradation will not occur for steels exposed to fluences less than 6×10^{17} n/cm^2. The maximum fluence for component supports at CCNPP, other than the reactor vessel supports, is significantly lower. Therefore, this aging mechanism is not plausible for supports within the scope of this report.

8. Supports inside containment are not subject to abuse/impacts from humans during normal operation. Any support degradation that may occur during an outage is corrected prior to re-start.

Table 2-1 (Continued)
Potential Age-Related Degradation Mechanisms Associated with Component Support Types

9. CCNPP Piping Design Standard DS-040 (Reference 2.8) does not require evaluation of support loads due to piping vibration, which implies that such loads are small relative to design loads. Design for fluid transients is mentioned in DS-040, but DS-040 does not classify such loads as normal operating loads, which implies that they are infrequent. Fatigue or wear due to hydraulic loadings is therefore not plausible for frame-type piping supports.

10. Frame-type piping supports are designed for friction loads due to thermal expansion which are small relative to other design loads, Therefore, fatigue or wear is not a plausible ARDM. (See Attachment 2 of CCNPP Design Standard DS-040.)

11. Elastomers used to dampen vibration are subject to age hardening, even in mild environments.

12. Elastomer isolators are intended to minimize the transfer of dynamic loads into the support base concrete or structural steel and anchors. Degradation of these anchorage elements, therefore, is not plausible. Degradation of the vibration isolator itself is considered to be included in "Elastomer Hardening."

13. Snubber supports are not susceptible to loading due to thermal expansion of piping/component. By design, the snubber does not restrict movement due to thermal growth but does restrict movement as a result of shock. This is different from the rest of the supports in the P-1-A and P-1-B groupings which do receive a thermal expansion load.

14. Instrumentation & control (I&C) cabinets which contain process fluids may have leakage onto floor which could corrode anchor bolts. During SVP walkdowns, SG Blowdown Sample Chiller No. 1C90 (in the Component Cooling Water system) was noted as having significant corrosion on the anchor bolts.

15. Transformer coil supports, including those in battery chargers and inverters, include insulation material in load path which may degrade over time.

16. Pump bases would be subject to corrosion due to pump shaft seal leakage if not coated with paint. At CCNPP, however, pump bases are coated with paint.

17. Supports designed for LOCA loading, e.g., those for the pressurizer and reactor coolant pumps, are designed such that thermal expansion is accommodated without significantly loading the supports.

18. The steel anchor chairs and bolts of outdoor large, flat-bottom, vertical tanks would be subject to corrosion due to rain and other forms of precipitation, if not coated with paint. At CCNPP, however, outdoor tank anchorage steel is coated with paint.

19. The concrete ring foundations of outdoor large, flat-bottom, vertical tanks are subject to thermal cycling, especially during periods of cold weather when their contents are heated with flow from warm sources, e.g, the main condenser.

Section 3

STRUCTURAL SUPPORTS COMMON TO THE SCOPES OF BOTH LICENSE RENEWAL AND SVP OR ISI

In Reference 1.1, BGE identified a total of 66 systems that are within the scope of license renewal (WSLR) for CCNPP. Of the 66 WSLR systems, 42 have component supports within the scope of this report. These systems are listed in Table 3-1, which shows systems corresponding to each of the 20 component support types discussed in Section 2. For convenience, Table 3-2 provides a cross reference between systems and their applicable component support types.

The 24 WSLR systems that are not included in this report are:

1. Systems that are really structures or structural elements: Intake Structure (system number 9), Primary Containment (59), Spent Fuel Storage (68), Refueling Pool (70), New Fuel Storage and Elevator (80), Cranes/Test Equipment (99), Plant Areas (doors) (102), Barriers and Barrier Penetrations (120), Auxiliary Building (no number), Condensate Storage Tank #12 Enclosure (no number), Fuel Oil Storage Tank No. 21 Building (no number), Switchgear Structure (no number), and Turbine Building (no number).

2. Systems that are not safety-related and whose structural supports require no special controls under the CCNPP current licensing basis and for which no II/I concerns would exist. For such systems, the structural support function is not an "intended function" (as defined in 54.4(b) of the license renewal rule). These systems include: Main Turbine (93), Fire and Smoke Detection (96), and Plant Communications (100).

3. Systems that are only required for containment isolation, and therefore are only important for valve closure, not for component support concerns: Extraction Steam (46), Plant Water (51), and Nitrogen and Hydrogen (74). Two other systems (Liquid Waste (71) and Plant Drains (53)) were not included in the scope of the review because they are WSLR only for containment isolation and drainage of fire fighting water/backflow of combustible materials. Overall, there are no component supports associated with these functions. The Cavity Cooling System (66) is only WSLR due to relays which cause the fans to trip (load shed) for certain design basis events. There are no component supports associated with this function.

4. Systems whose component supports have already been, or are being addressed separately: Reactor Vessel Internals (84), Fuel Assemblies (no number), and supports for the Reactor Vessels and Steam Generators are in this category.

To determine which of the 42 WSLR systems addressed in this report are covered by the CCNPP SVP or ISI Program, documentation from each program was reviewed. Table 3-1 summarizes the results of this review. Specifically, for each component support type, the table shows the applicable systems, and whether the system is included in the SVP or ISI Program. A description of the documentation reviewed and results of the review is provided in the following sections.

3.1 LICENSE RENEWAL VERSUS SVP SCOPE

Section 4 of this report provides a description of the CCNPP Seismic Verification Project (SVP). This program includes inspections and evaluations of the structural adequacy of supports for a variety of mechanical and electrical equipment. The components covered in the SVP are listed in the Safe Shutdown Equipment List (SSEL) (Reference 3.1).

For each component support type, Table 3-1 identifies the applicable systems and indicates whether the system is covered by SVP. In some cases, component supports for the entire system are covered; where this is not the case, an explanation of the extent of coverage is provided in the "Comments" section of the table.

3.2 LICENSE RENEWAL VERSUS ISI SCOPE

The CCNPP In-Service Inspection (ISI) Program is discussed in Section 5 of this report. This program includes examinations of piping supports in Class 1, 2 and 3 piping systems. The ISI Program scope also includes supports for some Class 1, 2 and 3 heat exchangers, and the reactor coolant pumps. The specific items covered in the current inspection interval of the ISI Program are documented in Reference 3.2.

For each component support type, Table 3-1 identifies the applicable systems and indicates whether the system is covered by the ISI Program. In some cases, component supports for the entire system are covered; where this is not the case, an explanation of the extent of coverage is provided in the "Comments" section of the table.

Table 3-1

Coverage of Component Support Types by Existing Programs

Component Support Type Number	Component Support Type	Systems Within Scope of License Renewal that Include Comp. Support Type (ID#)	Is WSLR Portion of System Included in ISI Scope?	Is WSLR Portion of System Included in SVP Scope?	Comments
P-1-A	Spring Hangers, Constant Load Supports, Sway Struts, Rod Hangers & Snubber Supports/ Outside Containment	Well & Pretreated Water (8)	No	N/A	License Renewal for fire protection only.
		Service Water Cooling (11)	Yes	N/A	Safety-related portions of system are covered by ISI Class 3 Program. Snubber supports are inspected by Technical Specification Surveillance Inspections.
		Salt Water Cooling (12)	Yes	N/A	Safety-related portions of system are covered by ISI Class 3 Program. Snubber supports are inspected by Technical Specification Surveillance Inspections.
		Fire Protection (13)	No	N/A	
		Component Cooling (15)	Yes	N/A	Safety-related portions of system are covered by ISI Class 3 Program. Snubber supports are inspected by Technical Specification Surveillance Inspections.
		Compressed Air (19)	No	N/A	
		Diesel Oil (23)	No	N/A	
		Diesel Generators (24)	Yes	N/A	Snubber supports are the only type of P-1-A support in this system. These are included in the ISI Class 3 Program and are inspected by Technical Specification Surveillance Inspections.
		Plant Heating (29)	No	N/A	License Renewal for fire protection only.

Table 3-1

Coverage of Component Support Types by Existing Programs

Component Support Type Number	Component Support Type	Systems Within Scope of License Renewal that Include Comp. Support Type (ID#)	Is WSLR Portion of System Included in ISI Scope?	Is WSLR Portion of System Included in SVP Scope?	Comments
P-1-A (Continued)	Spring Hangers, Constant Load Supports, Sway Struts, Rod Hangers & Snubber Supports / Outside Containment	Auxiliary F..dwater (36)	Yes	N/A	Safety-related portions of system are covered by ISI Class 3 Program.
		Demin. Water & Cond. Storage (37)	No	N/A	License Renewal for fire protection only.
		Sampling System (NSSS) (38)	No	N/A	
		Chemical & Volume Control (CVCS) (41)	Yes	N/A	Safety-related portions of system are covered by ISI Class 2 Program. Snubber supports are inspected by Technical Specification Surveillance Inspections.
		Condensate (44)	No	N/A	License Renewal for fire protection only.
		Feedwater (45)	Yes	N/A	Portion between containment and first valve outside containment is covered by ISI Class 2 Program. Snubber supports are inspected by Technical Specification Surveillance Inspections.
		Safety Injection (52)	Yes	N/A	Covered by ISI Class 2 Program. Snubber supports are inspected by Technical Specification Surveillance Inspections.
		Containment Spray (61)	Yes	N/A	Covered by ISI Class 2 Program. Snubber supports are inspected by Technical Specification Surveillance Inspections.
		Spent Fuel Pool Cooling (67)	Yes	N/A	Safety-related portions of system are covered by ISI Class 3 Program. Snubber supports are inspected by Technical Specification Surveillance Inspections.

Table 3-1

Coverage of Component Support Types by Existing Programs

Component Support Type Number	Component Support Type	Systems Within Scope of License Renewal that Include Comp. Support Type (ID#)	Is WSLR Portion of System Included in ISI Scope?	Is WSLR Portion of System Included in SVP Scope?	Comments
P-1-A	Spring Hangers, Constant Load Supports, Sway Struts, Rod Hangers & Snubber Supports/ Outside Containment	Well & Pretreated Water (8)	No	N/A	License Renewal for fire protection only.
		Service Water Cooling (11)	Yes	N/A	Safety-related portions of system are covered by ISI Class 3 Program. Snubber supports are inspected by Technical Specification Surveillance Inspections.
		Salt Water Cooling (12)	Yes	N/A	Safety-related portions of system are covered by ISI Class 3 Program. Snubber supports are inspected by Technical Specification Surveillance Inspections.
		Fire Protection (13)	No	N/A	
		Component Cooling (15)	Yes	N/A	Safety-related portions of system are covered by ISI Class 3 Program. Snubber supports are inspected by Technical Specification Surveillance Inspections.
		Compressed Air (19)	No	N/A	
		Diesel Oil (23)	No	N/A	
		Diesel Generators (24)	Yes	N/A	Snubber supports are the only type of P-1-A support in this system. These are included in the ISI Class 3 Program and are inspected by Technical Specification Surveillance Inspections.
		Plant Heating (29)	No	N/A	License Renewal for fire protection only.

Table 3-1 (Continued)

Coverage of Component Support Types by Existing Programs

Component Support Type Number	Component Support Type	Systems Within Scope of License Renewal that Include Comp. Support Type (ID#)	Is WSLR Portion of System Included in ISI Scope?	Is WSLR Portion of System Included in SVP Scope?	Comments
P-1-A (Continued)	Spring Hangers, Constant Load Supports, Sway Struts, Rod Hangers & Snubber Supports / Outside Containment	Auxiliary Feedwater (36)	Yes	N/A	Safety-related portions of system are covered by ISI Class 3 Program.
		Demin. Water & Cond. Storage (37)	No	N/A	License Renewal for fire protection only.
		Sampling System (NSSS) (38)	No	N/A	
		Chemical & Volume Control (CVCS) (41)	Yes	N/A	Safety-related portions of system are covered by ISI Class 2 Program. Snubber supports are inspected by Technical Specification Surveillance Inspections.
		Condensate (44)	No	N/A	License Renewal for fire protection only.
		Feedwater (45)	Yes	N/A	Portion between containment and first valve outside containment is covered by ISI Class 2 Program. Snubber supports are inspected by Technical Specification Surveillance Inspections.
		Safety Injection (52)	Yes	N/A	Covered by ISI Class 2 Program. Snubber supports are inspected by Technical Specification Surveillance Inspections.
		Containment Spray (61)	Yes	N/A	Covered by ISI Class 2 Program. Snubber supports are inspected by Technical Specification Surveillance Inspections.
		Spent Fuel Pool Cooling (67)	Yes	N/A	Safety-related portions of system are covered by ISI Class 3 Program. Snubber supports are inspected by Technical Specification Surveillance Inspections.

Table 3-1 (Continued)

Coverage of Component Support Types by Existing Programs

Component Support Type Number	Component Support Type	Systems Within Scope of License Renewal that Include Comp. Support Type (ID#)	Is WSLR Portion of System Included in ISI Scope?	Is WSLR Portion of System Included in SVP Scope?	Comments
P-1-A (Continued)	Spring Hangers, Constant Load Supports, Sway Struts, Rod Hangers & Snubber Supports/ Outside Containment	Main Steam (83)	Yes	N/A	Portion between containment and first valve outside containment is covered by ISI Class 2 Program. Two SR pipe segments in the Auxiliary Steam System are included in the Main Steam System Scope for License Renewal evaluations. Snubber supports are inspected by Technical Specification Surveillance Inspections.
P-1-B	Spring Hangers, Constant Load Supports, Sway Struts, Rod Hangers & Snubber Supports / Inside Containment	Service Water Cooling (11)	Yes	N/A	Covered by ISI Class 3 Program. Snubber supports are inspected by Technical Specification Surveillance Inspections.
		Fire Protection (13)	No	N/A	
		Compressed Air (19)	No	N/A	
		Auxiliary Feedwater (36)	Yes	N/A	Covered by ISI Class 3 Program. Snubber supports are inspected by Technical Specification Surveillance Inspections.
		Sampling System (NSSS) (38)	No	N/A	Snubber supports are inspected by Technical Specification Surveillance Inspections.
		Chemical & Volume Control (CVCS) (41)	Yes	N/A	Safety-related portions of system are covered by ISI Program (Classes 1, 2, and 3). Snubber supports are inspected by Technical Specification Surveillance Inspections.
		Feedwater (45)	Yes	N/A	Covered by ISI Class 2 Program. Snubber supports are inspected by Technical Specification Surveillance Inspections.

Table 3-1 (Continued)

Coverage of Component Support Types by Existing Programs

Component Support Type Number	Component Support Type	Systems Within Scope of License Renewal that Include Comp. Support Type (ID#)	Is WSLR Portion of System Included in ISI Scope?	Is WSLR Portion of System Included in SVP Scope?	Comments
P-1-B (Continued)	Spring Hangers, Constant Load Supports, Sway Struts, Rod Hangers & Snubber Supports / Inside Containment	Safety Injection (52)	Yes	N/A	Supports between RC Loop and isolation valves are covered by ISI Class 1 Program, and remainder, except the supports upstream of the SI tank check valves, are covered by ISI Class 2 Program. Snubber supports are inspected by Technical Specification Surveillance Inspections.
		Containment Spray (61)	Yes	N/A	Covered by ISI Class 2 Program. Snubber supports are inspected by Technical Specification Surveillance Inspections.
		Reactor Coolant System (064)	Yes	N/A	Snubber supports are covered by ISI Class 1 Program and are inspected by Technical Specification Surveillance Inspections.
		Spent Fuel Pool Cooling (67)	Yes	N/A	Covered by ISI Class 3 Program. Snubber supports are inspected by Technical Specification Surveillance Inspections.
		Main Steam (83)	Yes	N/A	Covered by ISI Class 2 Program. Snubber supports are inspected by Technical Specification Surveillance Inspections.
P-2-A	Piping Frames/ Outside Containment	---	---	---	Same systems as Spring Hangers, Constant Load Supports & Rod Hangers/Outside Containment (P-1-A).
P-2-B	Piping Frames/ Inside Containment	---	---	---	Same systems as Spring Hangers, Constant Load Supports & Rod Hangers/Inside Containment (P-1-B).
C-1-A	Channel, Clamp & Other Supporting Styles/ Outside Containment	N/A	N/A	Yes - Partial	All cable raceways in the Auxiliary Building and Intake Structure were included in the SVP. In the Turbine Building, only the raceways in the AFW pump rooms were included.

Table 3-1 (Continued)

Coverage of Component Support Types by Existing Programs

Component Support Type Number	Component Support Type	Systems Within Scope of License Renewal that Include Comp. Support Type (ID#)	Is WSLR Portion of System Included in ISI Scope?	Is WSLR Portion of System Included in SVP Scope?	Comments
C-1-B	Channel, Clamp & Other Supporting Styles / Outside Containment	N/A	N/A	Yes	All cable raceways in the Unit 1 and 2 Containments were included in the SVP.
H-1-A	Rod Hanger, Trapeze Supports/ Outside Containment	Control Room HVAC (30)	N/A	N/A	
		Aux Building and Radwaste H & V (32)	N/A	N/A	
H-1-B	Rod Hanger, Trapeze Supports/ Inside Containment	Primary Containment H & V (60)	N/A	N/A	
E-1	Elastomer Vibration Isolators (for Fans, Compressors, Chillers, & Air Handlers)/ Outside Containment	Control Room HVAC (30)	N/A	Yes	The chiller, which is not safety related, is not included in SVP, but the fans, compressors and air handlers are included.
		Aux Building and Radwaste H & V (32)	N/A	Yes - Portions	All WSLR subsystems except the Fuel Handling Area Subsystem are included in the SVP scope (i.e., Switchgear, EDG Room, Battery Room, ECCS Pump Room, and AFW Pump Room). (See E-6-A for switchgear room air handlers and compressors.)
E-2-A	Electrical Cabinet Anchorage (MCCs, SWGR, Distribution Panels, Control Panels)/ Outside Containment	Electrical 125 VDC Distribution (2)	N/A	Yes	
		Electrical 4KV Transformers and Buses (4)	N/A	Yes	Safety-related buses (switchgear) are included in SVP.

Table 3-1 (Continued)

Coverage of Component Support Types by Existing Programs

Component Support Type Number	Component Support Type	Systems Within Scope of License Renewal that Include Comp. Support Type (ID#)	Is WSLR Portion of System Included in ISI Scope?	Is WSLR Portion of System Included in SVP Scope?	Comments
E-2-A (Continued)	Electrical Cabinet Anchorage (MCCs, SWGR, Distribution Panels, Control Panels)/ Outside Containment	Electrical 480 V Transformers and Buses (5)	N/A	Yes - Portions	Safety-related buses (switchgear) are included in SVP. The only WSLR portions of this system not covered by SVP are the 4 CEDM breakers, which are WSLR for ATWS.
		Electrical 480 V MCCs (6)	N/A	Yes	Safety-related MCCs are included in SVP.
		Instrument AC (17)	N/A	No	The only WSLR portion of system 017 which is not SR are the breakers to the plant computer, which must be de-energized during a station blackout.
		Vital Instrument AC (18)	N/A	Yes	
		Data Acquisition Computer (20)	N/A	No	
		Emergency Diesel Generator (24)	N/A	Yes	Local relay cabinets are included in SVP.
		Annunciation (26)	N/A	N/A	Considered "Rule-of-the-Box" within Control Room cabinets and cable raceways.
		Sampling System (NSSS) (38)	N/A	Yes - Portions	Sampling "Hoods" are anchored similar to control panels. Three sampling hoods (RC Waste Concentrator Evaporators 11 and 12, and Misc. Waste Evaporator 11) are included in SVP.
		Emergency Safety Feature Actuation (ESFAS) (48)	N/A	Yes	ESFAS cabinets (in Cable Spreading Rooms) are included in SVP.
		Control Rod Drive Mechanism & Electrical (55)	N/A	No	
		Technical Support Center Computer (57)	N/A	No	

Table 3-1 (Continued)

Coverage of Component Support Types by Existing Programs

Component Support Type Number	Component Support Type	Systems Within Scope of License Renewal that Include Comp. Support Type (ID#)	Is WSLR Portion of System Included in ISI Scope?	Is WSLR Portion of System Included in SVP Scope?	Comments
E-2-A (Continued)	Electrical Cabinet Anchorage (MCCs, SWGR, Distribution Panels, Control Panels)/ Outside Containment	Reactor Protective (58)	N/A	Yes	Reactor trip switchgear are included in SVP.
		Control Boards (62)	N/A	Yes	All main control room panels are included in SVP.
		Reactor Coolant (64)	N/A	Yes	Reactor vessel level monitoring system (RVLMS) cabinets are included in SVP.
		Hydrogen Recombiner (73)	N/A	No	
		Area and Process Radiation Monitoring (77 & 79)	N/A	No	
		Nuclear Instrumentation (78)	N/A	No	
		Lighting and Power Receptacle (97)	N/A	No	
E-2-B	Electrical Cabinet Anchorage (MCCs, SWGR, Distribution Panels, Control Panels)/ Inside Containment	Area and Process Radiation Monitoring (77 & 79)	N/A	No	The WSLR portion of this system includes six radiation monitors.
E-3	Electrical Equipment That May Include Insulation Material in Anchorage Load Path (Transformers, Battery Chargers, Inverters)	Electrical 125 VDC Distribution (2)	N/A	Yes	Battery chargers and inverters are included. (Ther are no transformers.)
		Electrical 4KV Transformers and Buses (4)	N/A	Yes - Portions	Safety-related transformers are included in SVP.

Table 3-1 (Continued)

Coverage of Component Support Types by Existing Programs

Component Support Type Number	Component Support Type	Systems Within Scope of License Renewal that Include Comp. Support Type (ID#)	Is WSLR Portion of System Included in ISI Scope?	Is WSLR Portion of System Included in SVP Scope?	Comments
E-3 (Continued)	Electrical Equipment That May Include Insulation Material in Anchorage Load Path	Electrical 480V Transformers and Buses(5)	N/A	Yes - Portions	Safety-related transformers are included in SVP.
E-4-A	Equipment Frames (Instr. on Racks & Batteries on Racks)/ Outside Containment	Electrical 125 VDC Distribution (2)	N/A	Yes	125 VDC distribution batteries on racks are included in SVP.
		Well and Pretreated Water (8)	N/A	No	License Renewal for fire protection only.
		Service Water Cooling (11)	N/A	Yes - Portions	Transmitters and switches are included in SVP.
		Salt Water Cooling (12)	N/A	Yes	Pressure transmitters are included in SVP.
		Fire Protection (13)	N/A	Yes - Portions	Fire pump battery racks are included in SVP.
		Component Cooling (15)	N/A	Yes - Portions	Some instruments are included in SVP.
		Compressed Air (19)	N/A	Yes	Level and temp. switches are included in SVP.
		Diesel Oil (23)	N/A	No	
		Emergency Diesel Generator (24)	N/A	Yes	Level switches and pressure control switches are included in SVP.
		Plant Heating (29)	N/A	No	License Renewal for fire protection only.
		Control Room HVAC (30)	N/A	Yes	Control Room HVAC instruments are included in SVP except for those associated with the chiller, which is not safety-related.

Table 3-1 (Continued)

Coverage of Component Support Types by Existing Programs

Component Support Type Number	Component Support Type	Systems Within Scope of License Renewal that Include Comp. Support Type (ID#)	Is WSLR Portion of System Included in ISI Scope?	Is WSLR Portion of System Included in SVP Scope?	Comments
E-4-A (Continued)	Equipment Frames (Instr. on Racks & Batteries on Racks)/ Outside Containment	Auxiliary Building & Radwaste H & V (32)	N/A	Yes - Portions	Instruments associated with all WSLR subsystems, except the Fuel Handling Area Subsystem, are included in the SVP scope (i.e., Switchgear, EDG Room, Battery Room, ECCS Pump Room, and AFW Pump Room).
		Auxiliary Feedwater (36)	N/A	Yes	Pressure and flow transmitters are included in SVP.
		Sampling System (NSSS) (38)	N/A	No	
		Chemical & Volume Control (CVCS) (41)	N/A	Yes	Instruments for the safety-related components in the CVCS system (e.g., BA storage tank, VCT, RWT, and charging pumps) are included in SVP.
		Circulating Water (42)	N/A	No	License Renewal due to high level alarms in intake pit.
		Condensate (44)	N/A	Yes - Portions	License Renewal for fire protection only.
		Feedwater (45)	N/A	No	
		Safety Injection (52)	N/A	Yes	Pressure and flow transmitters are included in SVP.
		Containment Spray (61)	N/A	No	
		Spent Fuel Pool Cooling (67)	N/A	Yes	The 12 instruments required by plant EOP are included in SVP.
		Waste Gas (69)	N/A	No	
		Main Steam (83)	N/A	No	

Table 3-1 (Continued)

Coverage of Component Support Types by Existing Programs

Component Support Type Number	Component Support Type	Systems Within Scope of License Renewal that Include Comp. Support Type (ID#)	Is WSLR Portion of System Included in ISI Scope?	Is WSLR Portion of System Included in SVP Scope?	Comments
E-4-B	Equipment Frames (Instr. on Racks)/ Inside Containment	Fire Protection (13)	N/A	No	
		Sampling System (NSSS) (38)	N/A	No	
		Chemical & Volume Control (CVCS) (41)	N/A	No	
		Feedwater (45)	N/A	No	Eight SG level transmitters and eight pressure transmitters in each containment are included in SVP.
		Safety Injection (52)	N/A	No	Containment sump level instruments are not included in SVP.
		Reactor Coolant (64)	N/A	Yes	25 instruments in each containment are included in SVP.
		Hydrogen Recombiner (73)	N/A	No	
		Main Steam (83)	N/A	No	
E-5-A	Frames & Saddles (Tanks & HXs)/ Outside Containment	Service Water Cooling (11)	Yes	Yes	Service Water Head Tanks, Heat Exchangers, and SFP Cooler HXs, are included in SVP. Service Water HXs are covered by ISI Class 3 Program.
		Salt Water Cooling (12)	N/A	Yes	ECCS room air coolers are classified as heat exchangers.
		Fire Protection (13)	N/A	Yes - Portions	Fire Pump Fuel Oil Tank is included in SVP.
		Component Cooling (15)	Yes	Yes	Comp. cooling HX's (see cont. spray for shutdown HXs) penetration coolers, head tank, chem. addition tank, are included in SVP. CCW HX's are also covered by ISI Class 3 Program.

Table 3-1 (Continued)

Coverage of Component Support Types by Existing Programs

Component Support Type Number	Component Support Type	Systems Within Scope of License Renewal that Include Comp. Support Type (ID#)	Is WSLR Portion of System Included in ISI Scope?	Is WSLR Portion of System Included in SVP Scope?	Comments
E-5-A (Continued)	Frames & Saddles (Tanks & HXs)/ Outside Containment	Compressed Air (19)	N/A	Yes	Compressed air system receivers and accumulators are included in SVP.
		Diesel Oil (23)	N/A	Yes	See E-8 for Diesel Oil Storage Tanks.
		Emergency Diesel Generator (24)	Yes - Portions	Yes - Portions	All EDG tanks and HXs from the Start Air, Cooling Water, Fuel and Lube Oil subsystems are included in SVP, except those associated with waste oil. Also, EDG HXs are covered by ISI.
		Plant Heating (29)	N/A	No	License Renewal for fire protection function of providing freeze protection for PWSTs.
		Auxiliary Feedwater (36)	N/A	N/A	See E-8 for Condensate Storage Tank 12.
		Sampling System (NSSS) (38)	N/A	N/A	Sampling system hoods contain small heat exchangers, which are considered Rule-of-the-Box within hood cabinet. (see E-2-A).
		Chemical & Volume Control (CVCS) (41)	Yes	Yes	Boric Acid Storage and Volume Control Tanks an Letdown HXs are included in SVF and ISI.
		Containment Spray (61)	Yes	Yes	Shutdown cooling HXs are covered by the ISI Class 3 Program and are included in SVP.
		Reactor Coolant (64)	N/A	Yes	Blowdown tanks and HXs are included in SVP.
		Spent Fuel Pool Cooling (67)	N/A	Yes - Portions	See Service Water for HXs. Demineralizers and filters are not included in SVP.
		Waste Gas (69)	N/A	No	Waste Gas tanks are not included in SVP.

Table 3-1 (Continued)

Coverage of Component Support Types by Existing Programs

Component Support Type Number	Component Support Type	Systems Within Scope of License Renewal that Include Comp. Support Type (ID#)	Is WSLR Portion of System Included in ISI Scope?	Is WSLR Portion of System Included in SVP Scope?	Comments
E-5-B	Frames & Saddles (Tanks & HXs)/ Inside Containment	Chemical & Volume Control (CVCS) (41)	Yes	Yes	Regenerative HX's are included in both ISI and SVP.
		Safety Injection (52)	N/A	No	Safety Injection Tanks are not included in SVP. These tanks are covered by ISI, but are exempted from inspection at CCNPP. See E-8 for Refueling Water Storage Tanks.
		Reactor Coolant (64)	N/A	Yes - Portions	Quench tank and SG support coolers are covered by SVP. SG's are outside scope of this report. Pressurizer is covered under E-7.
		Hydrogen Recombiner (73)	N/A	No	H_2 recombiner is not included in SVP.
E-6-A	Metal Spring Isolators & Fixed Bases (Pumps, Fans, Air Handlers, Chillers, Air Compressors, M-G Sets, EDGs)/ Outside Containment	Well and Pretreated Water (8)	N/A	No	License Renewal for fire protection only.
		Service Water Cooling (11)	N/A	Yes	Service water pumps are included in SVP.
		Salt Water Cooling (12)	N/A	Yes	Salt water pumps are included in SVP.
		Fire Protection (13)	N/A	Yes - Portions	Fire Pumps 11, 12 and 13 are included in SVP, but jockey and makeup pumps are not.
		Component Cooling (15)	N/A	Yes	Component cooling pumps are included in SVP.
		Compressed Air (19)	N/A	Yes	Salt water air compressors are included in SVP.

Table 3-1 (Continued)

Coverage of Component Support Types by Existing Programs

Component Support Type Number	Component Support Type	Systems Within Scope of License Renewal that Include Comp. Support Type (ID#)	Is WSLR Portion of System Included in ISI Scope?	Is WSLR Portion of System Included in SVP Scope?	Comments
E-6-A (Continued)	Metal Spring Isolators & Fixed Bases/ Outside Containment	Diesel Oil (23)	N/A	Yes - Portions	Fuel oil transfer pumps, EDG drip pumps, and fire pump fuel supply pump are included in SVP, but the fuel oil unloading pump is not.
		Emergency Diesel Generator (24)	N/A	Yes	EDGs, and pumps and air compressors associated with the Start Air and Cooling Water subsystems are included in the SVP. (see Diesel Oil for fuel pumps.)
		Plant Heating (29)	N/A	No	License Renewal for fire protection only.
		Auxiliary Building and Radwaste H & V (32)	N/A	Yes - Portions	SWGR room air handlers and A/C compressors are included in SVP. (The air handlers are not on vibration isolators, and the compressors are on spring-type isolators.)
		Auxiliary Feedwater (36)	N/A	Yes	AFW pumps are included in SVP.
		Chemical & Volume Control (CVCS) (41)	Yes	Yes	Charging and Boric Acid pumps are included in SVP and ISI.
		Condensate (44)	N/A	No	License Renewal for fire protection only.
		Safety Injection (52)	N/A	Yes	LPSI and HPSI pumps are included in SVP.
		Containment Spray (61)	N/A	No	Containment spray pumps are not included in SVP
		Spent Fuel Pool Cooling (67)	N/A	Yes	SFP cooling pumps are included in SVP.

Table 3-1 (Continued)

Coverage of Component Support Types by Existing Programs

Component Support Type Number	Component Support Type	Systems Within Scope of License Renewal that Include Comp. Support Type (ID#)	Is WSLR Portion of System Included in ISI Scope?	Is WSLR Portion of System Included in SVP Scope?	Comments
E-6-B	Metal Spring Isolators & Fixed Bases (Pumps, Fans, Air Handlers, Chillers, Air Compressors, M-G Sets, EDGs)/ Inside Containment	Primary Containment H&V (60)	N/A	Yes	Containment coolers are included in SVP.
		Reactor Coolant (64)	Yes	No	See E-7 for RCPs.
E-7	LOCA Restraints (PZR & RC Pump)/ Inside Containment	Reactor Coolant (64)	Yes	No	Pressurizer skirt and RCP supports are covered by ISI Class 1 Program.
E-8	Ring Foundation for Flat-bottom Vertical Tanks/ Outside	Well and Pretreated Water (8)	N/A	Yes	The 2 Pretreated Water Storage Tanks (PWSTs) are included in SVP.
		Diesel Oil (23)	N/A	Yes	The 2 Diesel Oil Storage Tanks are included in SVP.
		Auxiliary Feedwater (36)	Yes	Yes	Condensate Storage Tank (CST) 12 is included in ISI and SVP.
		Demin. Water and Condensate Storage (37)	Yes	Yes	Condensate Storage Tanks (CSTs) 11 and 21 are included in ISI and SVP.
		Safety Injection (52)	N/A	Yes	The 2 Refueling Water Tanks (RWTs) are include in SVP.

Table 3-2
Cross-Reference of Systems Within Scope of
License Renewal and Component Support Types

System Within Scope of License Renewal (ID#)	Component Support Type Number
Electrical 125 Volt DC Distribution (2)	E-2-A, E-3, E-4-A
Electrical 4KV Transformers and Buses (4)	E-2-A, E-3
Electrical 480V Transformers and Buses (5)	E-2-A, E-3
Electrical 480V Motor Control Centers (6)	E-2-A
Well and Pretreated Water (8)	P-1-A, P-2-A, E-4-A, E-6-A, E-8
Service Water Cooling (11)	P-1-A, P-2-A, P-1-B, P-2-B, E-4-A, E-5-A, E-6-A
Salt Water Cooling (12)	P-1-A, P-2-A, E-4-A, E-5-A, E-6-A
Fire Protection (13)	P-1-A, P-2-A, P-1-B, P-2-B, E-4-A, E-4-B, E-5-A, E-6-A
Component Cooling (15)	P-1-A, P-2-A, E-4-A, E-5-A, E-6-A
Instrument AC (17)	E-2-A
Vital Instrument AC (18)	E-2-A
Compressed Air (19)	P-1-A, P-2-A, P-1-B, P-2-B, E-4-A, E-5-A, E-6-A
Data Acquisition Computer (20)	E-2-A
Diesel Oil (23)	P-1-A, P-2-A, E-4-A, E-5-A, E-6-A, E-8
Emergency Diesel Generator (24)	P-1-A, E-2-A, E-4-A, E-5-A, E-6-A
Annunciation (26)	E-2-A
Plant Heating (29)	P-1-A, P-2-A, E-4-A, E-5-A, E-6-A
Control Room HVAC (30)	H-1-A, E-1-A, E-4-A
Auxiliary Building and Radwaste H&V (32)	H-1-A, E-1-A, E-4-A, E-6-A
Auxiliary Feedwater (36)	P-1-A, P-2-A, P-1-B, P-2-B, E-4-A, E-5-A, E-6-A, E-8
Demin. Water and Condensate Storage (37)	P-1-A, P-2-A, E-8

Table 3-2 (Continued)
Cross-Reference of Systems Within Scope of
License Renewal and Component Support Types

System Within Scope of License Renewal (ID#)	Component Support Type Number
Sampling System (NSSS) (38)	P-1-A, P-2-A, P-1-B, P-2-B, E-2-A, E-4-A, E-4-B, E-5-A
Chemical and Volume Control (CVCS) (41)	P-1-A, P-2-A, P-1-B, P-2-B, E-4-A, E-4-B, E-5-A, E-5-B, E-6-A
Circulating Water (42)	E-4-A
Condensate (44)	P-1-A, P-2-A, E-4-A, E-6-A
Feedwater (45)	P-1-A, P-2-A, P-1-B, P-2-B, E-4-A, E-4-B
Emergency Safety Feature Actuation (ESFAS) (48)	E-2-A
Safety Injection (52)	P-1-A, P-2-A, P-1-B, P-2-B, E-4-A, E-4-B, E-5-B, E-6-A, E-8
Control Rod Drive Mechanism & Electrical (55)	E-2-A
Technical Support Center Computer (57)	E-2-A
Reactor Protective (58)	E-2-A
Primary Containment H&V (60)	H-1-B, E-6-B
Containment Spray (61)	P-1-A, P-2-A, P-1-B, P-2-B, E-4-A, E-5-A, E-6-A
Control Boards (62)	E-2-A
Reactor Coolant (64)	E-2-A, E-4-B, E-5-A, E-5-B, E-6-B, E-7
Spent Fuel Pool Cooling (67)	P-1-A, P-2-A, P-1-B, P-2-B, E-4-A, E-5-A, E-6-A
Waste Gas (69)	P-2-A, E-4-A, E-5-A
Hydrogen Recombiner (73)	E-2-A, E-4-B, E-5-B
Area and Process Radiation Monitoring (77 & 79)	E-2-A, E-2-B
Nuclear Instrumentation (78)	E-2-A
Main Steam (83)	P-1-A, P-2-A, P-1-B, P-2-B, E-4-A, E-4-B
Lighting and Power Receptacle (97)	E-2-A

Section 4

SVP AND FOLLOW-ON ACTIVITIES AS AGING MANAGEMENT PROGRAMS

4.1 BRIEF DESCRIPTION OF THE SQUG-DEVELOPED EARTHQUAKE EXPERIENCE BASIS AND SEISMIC VERIFICATION PROCESS

The Seismic Verification Project (SVP) was established at CCNPP to resolve the NRC's Unresolved Safety Issue A-46 on the seismic adequacy of older nuclear power plants. The SVP is using the NRC-approved Generic Implementation Procedure (GIP) (Reference 4.1) to verify the seismic adequacy of mechanical and electrical equipment required for safe shutdown following a seismic event. The seismic adequacy of electrical cable raceways (trays and conduit) is also evaluated using GIP criteria.

The SVP program uses the Seismic Qualification Utility Group (SQUG) methodology, whose acceptance criteria are based on the as-found condition of equipment and raceways in over 80 industrial facilities that experienced strong-motion earthquakes. A list of these facilities, and their approximate age at the time of their post-earthquake condition assessments, is included in Appendix A of this report. It should be noted that the average age of these facilities at the time of their condition assessments was 22 years old, including 11 facilities over 40 years old. That is, many equipment items and raceways in the database had already been subject to significant aging (but not necessarily significant degradation), and still survived large seismic loadings with no significant damage. The GIP acceptance criteria are specifically based on the features or condition of damaged equipment or raceways in the database that caused them to be more structurally vulnerable than other similar equipment that was not damaged. Any equipment support condition found that does not meet the GIP criteria (and therefore might not be able to perform its intended function) is documented as an "outlier," and is evaluated further to determine what, if any, corrective action or modification is needed to resolve the outlier concern.

A significant requirement of the SQUG methodology is that walkdown evaluations be conducted by "Seismic Capability Engineers." In accordance with the GIP (Section 2.4 of Reference 4.1), Seismic Capability Engineers are degreed engineers with at least five years of experience in earthquake engineering applicable to nuclear power plants, and in structural or mechanical engineering. Additionally, these engineers must complete the SQUG-developed Walkdown Training Course for Seismic Capability Engineers. This course includes reviews of the GIP walkdown evaluation criteria, including criteria for evaluating the condition of equipment anchorages for the variety of anchor types used in nuclear power plants.

One area of seismic vulnerability that was found to apply to many types of equipment in the SQUG database was inadequate anchorage. The GIP methodology, therefore, places significant

emphasis on confirming the structural adequacy of the as-found condition of equipment support load paths and anchorage. GIP anchorage evaluation requirements include the following actions, performed by the Seismic Capability Engineers:

- Field walkdowns documented on standardized checklists for each generic class of equipment. Checklist questions include evaluation of concrete strength/condition, concrete cracking, grout pad adequacy, weld quality/condition for welded anchorages, and anchor bolt adequacy.

- Calculations of the anchorage capacity vs. seismic loading (demand).

- Photographs of equipment anchorage are not mandatory per the GIP, but have been required by most plants, including CCNPP.

The SQUG walkdown checklists (Screening and Evaluation Work Sheets, or SEWS forms) also include requirements to evaluate whether overhead or nearby equipment and distributive systems are likely to collapse, i.e., whether a seismic class II-over-class I concern exists.

Although the majority of the SQUG evaluation methodology is based on visual inspections, there is one part of the anchorage evaluation criteria that requires a "hands-on" inspection. This hands-on inspection applies to concrete expansion anchors, which are used extensively in power plants to anchor equipment such as cabinets, instrument/battery racks and stanchions. The inspection (called the "anchor tightness check" in Section C.2.3 of Reference 4.1) requires applying a small torque to the anchor to confirm the bolt is tight and adequately installed. These checks were performed by CCNPP craft personnel on a sampling of anchor bolts selected by the Seismic Capability Engineers.

4.2 DESCRIPTION OF SVP FOLLOW-ON ACTIVITIES

Because the SVP is a one-time occurring, baseline activity, its use as an aging management program for component supports is supplemented by the ongoing walkdowns by system engineers, and other plant personnel. These follow-on activities are discussed in the following sections.

4.2.1 Walkdowns by System Engineers

CCNPP Plant Engineering guidelines instruct system engineers to perform periodic walkdowns. Visual inspections are required for component supports during these walkdowns.

The primary objective of the system engineer walkdowns is to ensure the safety and power generation functionality of the system. The system engineer is instructed to look for signs of

component support stress or abuse, such as thermal insulation damage; bent, broken, or misadjusted hangers; distress to equipment anchorage; excessive piping motion or vibration; damaged tubing or flexible conduit; and degraded condition of painted surfaces. In addition, system engineers are specifically instructed to perform a periodic visual inspection of equipment anchorage, pipe supports, and cable raceways to confirm structural soundness and functionality, including checking for damaged supports or missing nuts and bolts. System engineers document results of walkdowns in a monthly field walkdown report. Additionally, the QL-2-100 (Issue Reporting and Corrective Action) process requires all plant personnel, including system engineers, to formally document any discrepancy they observe in the plant.

System engineers interviewed reported occasionally identifying component support deficiencies like those that would occur with aging, such as broken or missing clips on tubing, and corrosion on anchorages. In addition, system engineers report that experienced BGE personnel monitor field walkdown reports, maintenance orders, issue reports (CCNPP's method of documenting plant deficiencies), and published information from other nuclear plants, to determine if generic problems are occurring with specific components.

4.2.2 Walkdowns by Plant Operations Personnel

CCNPP administrative procedures for plant operations personnel define the following responsibilities for watchstanders in the turbine building, auxiliary building, service building, intake structure, diesel generator rooms, and outside areas:

- Perform general inspections and checking of the condition of areas and equipment.
- Promptly report any hazardous or unusual conditions or occurrences to the Control Room.
- Thoroughly assess degraded equipment conditions (particularly problems in high energy systems), including obtaining assistance from Plant Engineering, Design Engineering, and/or Maintenance.

System engineers interviewed report that operators have been trained to identify component support problems such as broken or missing tubing clips. In addition, as described above, operators are required to report unusual conditions, some of which, e.g., excessive heat or accumulation of water in a space, could result in degradation of component support if uncorrected.

4.2.3 Responsibilities of Other Plant Personnel

Specific sections and units within CCNPP are assigned ownership of certain plant spaces. Personnel from these sections and units are required to maintain the housekeeping and

cleanliness of the space, and to monitor the material condition of equipment within the space. Specific requirements related to potential age related degradation mechanisms or indications include checking for leaks; clogged drains; excessive motor or generator vibration; unsecured cables or leads; loose or unbracketed pipes; loose, stripped or missing fasteners; missing piping insulation; and rust, corrosion, or inadequate paint.

4.2.4 Vibration Monitoring as a Tool to Manage Aging of Component Supports

CCNPP has a program for monitoring the vibration of rotating machinery. The components included in this program which are in systems within the scope of license renewal are summarized in Table 4-1.

In this program, periodic vibration measurements are made for rotating machinery, and the measurements are trended and compared to baseline measurements. If the vibration exceeds an established alert value, the program requires documentation of the problem, probable cause, and recommended solutions.

This program's primary purpose is not identification of support degradation. However, because degraded anchorages can increase vibration levels for rotating machinery, degraded supports could be identified. It is noted that plant personnel associated with the program do not recall any cases in which support degradation was identified based on vibration data.

4.3 JUSTIFICATION THAT SVP AND FOLLOW-ON ACTIVITIES ARE ADEQUATE TO MANAGE THE EFFECTS OF AGING FOR LICENSE RENEWAL

The CCNPP SVP Program and the follow-on activities described in Section 4.2 are adequate to manage the effects of aging in component supports for the following reasons:

- The visual inspections performed by the SVP Program include checks for the following potential ARDMs described in Table 2-1:

  - Grout/Concrete Local Deterioration
  - Steel load path and concrete pad degradation potentially caused by Loadings from Rotating/Reciprocating Machinery, Hydraulic Vibration or Water Hammer, and Thermal Expansion of Piping/Component

  Because the SVP inspections were performed after approximately 20 years of plant life, there is reasonable assurance that these ARDMs are not active if they were not discovered during the SVP inspections.

- The visual inspections performed by the SVP Program and the System Engineer Walkdowns include checks for the following potential ARDMs described in Table 2-1:

  - General Corrosion of Steel
  - Elastomer Hardening
  - Abuse, Impacts, Accidents

- The SVP does not visually check for the presence of SCC. However, as discussed in Section 2, this aging mechanism is only plausible for equipment supports if high strength anchor bolting was installed for these supports at CCNPP. The SVP inspections, including anchor tightness checks, did not discover any high strength concrete expansion anchors installed at CCNPP, providing additional assurance that SCC is not a concern for license renewal.

The CCNPP System Engineer Walkdowns (along with the other programs described in Section 4.2 of this report) are judged adequate to continue monitoring the active ARDMs listed above on the basis that (1) the guidelines for these walkdowns require the system engineers to look for component support condition concerns, (2) the system engineers are required to document the results of their walkdowns monthly, and (3) systems engineers occasionally find component support deficiencies like those that would occur due to aging (which indicates that component support aging is being managed). Additionally, because CCNPP is intending to commit to the SQUG methodology as a alternate method to verify the seismic adequacy of new and replacement equipment, Seismic Capability Engineers will be available to assist the Systems Engineers, as required, in evaluating cases of questionable component support condition.

Table 4-1

CCNPP Vibration Monitoring Program
Components Within the Scope of License Renewal

Auxiliary Feedwater Pumps	Fire Protection Pumps
Boric Acid Pumps	High Pressure Safety Injection Pumps
Charging Pumps	Low Pressure Safety Injection Pumps
Component Cooling Pumps	Reactor Coolant Pumps
Control Room HVAC	Salt Water Pumps
Containment Spray Pumps	Service Water Pumps
ECCS Pump Room Exhaust Fans	Spent Fuel Pool Cooling Pumps
Emergency Diesel Generator	Switchgear HVAC Air Handlers
EDG Turbochargers	

Section 5

COMPONENT SUPPORT ISI AS AN AGING MANAGEMENT PROGRAM

5.1 BRIEF DESCRIPTION OF THE SECTION XI ISI REQUIREMENTS FOR PIPING SUPPORTS

CCNPP Technical Specification 4.0.5 (a) (Reference 5.1) requires that inservice inspection of ASME Code Class 1, 2, and 3 components be performed in accordance with Section XI of the ASME code. Further, Technical Specification 4.4.10.1.2 (Reference 5.2) requires augmented inspection of portions of the main steam and feedwater piping. The CCNPP ISI Program Plan (Reference 3.2) describes the inspections performed to satisfy these requirements.

The ISI Program at CCNPP for the current (second) inspection interval was developed in accordance with ASME Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components" (Reference 5.3). Specifically, Subsection IWF of Section XI describes the examination requirements for component supports for Class 1, 2 and 3 piping systems. For CCNPP, the ISI Program scope covers supports for the systems and components listed in Table 5-1.

5.1.1 Specific Requirements of Section XI

Section XI Subsection IWF defines component supports as those metal supports that are designed to transmit loads from the component and piping to the load carrying building or foundation structures. This includes the attachment portion of intervening element(s) to pressure retaining components, integral and nonintegral attachments of pressure retaining components, and integral and nonintegral supports.

The examination requirements of Subsection IWF apply to plate and shell type supports (supports fabricated from plate and shell elements, such as vessel skirts and saddles, normally subject to biaxial stress), linear type supports (supports acting under essentially a single component of stress, such as tension and compression struts, beams and columns, trusses, frames, arches, rings and cables), and component standard supports (support assemblies consisting of one or more generally mass produced units usually referred to as catalog items). Requirements are provided for parts to be examined, examination frequency, methods, acceptance standards, and additional examinations.

- Section XI requires the following parts to be examined for plate and shell type supports, linear type supports and component standard supports:
    - Mechanical connections to pressure retaining components and building structure
    - Weld connections to building structure
    - Weld and mechanical connections at intermediate joints in multiconnected integral and nonintegral supports
    - Component displacement settings of guides and stops, misalignment of supports, assembly of support items

  In addition, for component standard supports, Section XI requires that spring type support and constant load type support parts be examined.

- The Section XI examination frequency for component supports is once per inspection interval. BGE has elected to perform these examinations in 10 year intervals. The current inspection interval, the second for each unit, began April 1, 1987.

- Examination methods required by Section XI for supports are VT-3 and VT-4. The VT-3 examination is a visual examination to determine the general mechanical and structural condition of the support, including checking for the presence of loose parts, debris, or abnormal corrosion products, wear, erosion, corrosion, and the loss of integrity at bolted or welded connections. VT-3 examination includes the measurement of clearances, detection of physical displacement, structural adequacy of supporting elements, connections between load carrying structural members, and tightness of bolting. The VT-4 examination is a visual examination conducted to confirm the functional adequacy of the support, verification of settings, or freedom of motion. This examination may require disassembly of components and operability tests.

- Acceptance standards from Section XI for component support structural integrity are summarized in Table 5-2.

- When results of examinations require corrective measures, Section XI requires additional examinations be performed. Specifically, component supports immediately adjacent to those requiring corrective action shall be examined. Also, the examinations shall be extended to include additional supports equal in number and similar in type, design, and function to those initially examined during the inspection. When these additional

examinations require corrective measures, the remaining component supports within the system of the same type, design, and function shall be examined.

5.1.2 CCNPP Implementation of the ISI Program Plan

The CCNPP ISI Program Plans and Long Term Plans for each unit document the following information for component support inservice inspection:

- Supports for each Class 1, 2, and 3 component and system in the ISI Program scope;
- The non-destructive examination method to be employed for each support inspection;
- The schedule for each inspection;
- The parts to be examined for each support; and
- Reference drawings for each component support.

Component support visual examinations are performed in accordance with a CCNPP procedure which meets the intent of Section XI. The result of each inspection is documented in an outage report. Review of typical inspection documentation shows that on occasion deficiencies are found, such as loose clamp bolts. CCNPP personnel report that on these occasions the deficiency is corrected and additional supports are inspected.

5.2 DESCRIPTION OF ISI FOLLOW-ON ACTIVITIES

Continued Inservice Inspection of component supports covered by the ISI Program, at the intervals described in the governing documents, will serve as the follow-on activity for component supports included in this program. For component supports not included in the ISI Program, the activities described in Section 4.2 will serve as the follow-on activities for on-going aging management unless specific aging concerns are identified which warrant more aggressive aging management practices.

5.2.1 Snubber Visual Inspection Surveillance

For snubber supports, the CCNPP Technical Specifications section 4.7.8.1 requires inspections of snubbers and snubber supports at more frequent intervals than is required by Section XI ISI. These more frequent inspections are also credited as a follow-on aging management activity for snubber supports. The systems covered by the snubber inspection surveillance are shown in Table 5-3.

5.3 JUSTIFICATION THAT THE ISI PROGRAM IS ADEQUATE TO MANAGE THE EFFECTS OF AGING FOR LICENSE RENEWAL

The CCNPP ISI Program is adequate to manage the effects of aging in component supports within the program scope for the following reasons:

- The visual examination procedure requires that the component supports be checked for the effects of the following potential age-related degradation mechanisms:
  - General corrosion of steel
  - Stress corrosion cracking of high strength steel bolts
  - Vibration or thermal expansion cycles (loosening of bolted or pinned connections, loss of weld integrity, component displacement or misalignment, and hanger setting drift)
- Inspections performed to date have identified deficiencies like those associated with aging degradation.
- The program requires that each support be inspected at regular intervals; as evidenced by the relatively small number of support deficiencies found to date, it appears that the inspection interval (10 years) is adequate for detecting degradation.
- The program requires expansion of the inspection scope in the event that degradation of component supports is observed; this reduces the likelihood that widespread degradation is occurring without notice in other supports in the affected system or other systems with like supports.
- The outage reports prepared after each inspection period provide historical information for supports.

The snubber visual inspection surveillance is considered to be an acceptable on-going aging management program to supplement the ISI program for snubber supports for the following reasons:

- The ARDMs which were determined to be plausible for snubber supports are general corrosion of steel, loading due to hydraulic vibration or water hammer and loading due to other abuse, impacts or accidents. The effects of all of these aging mechanisms are detectable by the visual inspection techniques employed during the snubber visual inspection surveillance.

- In addition to the active snubber which is not subject to aging management review, the visual inspection includes steps to check the snubber supports. Checks include verification that snubber installation exhibits no visual indications of detachment from foundation or supporting structures including clamps, welds, Hilti bolts and general condition of concrete as well as steps to verify that pipe clamp/rod eye bracket is in satisfactory condition and snubber is properly aligned.
- The visual inspection procedure requires reporting the discovery of unacceptable snubber or snubber support conditions and expanding the inspection scope to include all snubbers and snubber supports within the given inspection group.
- Personnel performing these inspections must be qualified in accordance with the requirements of ASME Section XI.
- The Surveillance Test Procedures (STPs) governing these visual inspections are controlled by site processes for review and approval of STPs.

Table 5-1

Scope of CCNPP ISI Program

Class	Systems and Components Included in the CCNPP ISI Program
Class 1	Vessels Reactor Pressure Vessel Pressurizer Steam Generators (Primary Side)
	Piping (Note 1) Reactor Coolant System Pressurizer Surge Line Shutdown Cooling System Safety Injection System Pressurizer Spray System Pressurizer Safety and Relief System Charging Lines Letdown Lines Drain Lines
	Pumps Reactor Coolant Pumps
	Valves (Note 2) Safety Injection System Pressurizer Spray System Shutdown Cooling System Pressurizer Safety and Relief System Charging Lines Letdown Lines
Class 2	Vessels Steam Generators (Secondary Side) Shutdown Cooling Heat Exchangers Regenerative Heat Exchangers
	Piping (Note 1) Safety Injection System Containment Spray System Shutdown Cooling System Main Steam System (Note 3) Feedwater System (Note 4)

Table 5-1 (Continued)

Scope of CCNPP ISI Program

Class	Systems and Components Included in the CCNPP ISI Program
Class 3	Systems (Note 1) Auxiliary Feedwater System Shutdown Cooling System Component Cooling System Service Water System Salt Water System Spent Fuel Pool Cooling System
	Components Containment Spray/Shutdown Cooling Heat Exchangers Service Water Heat Exchangers Service Water Head Tanks Condensate Storage Tanks 11 and 21 Component Cooling Water Heat Exchangers Component Cooling Water Head Tanks Emergency Diesel Generator Air Cooler Heat Exchangers Emergency Diesel Generator Lube Oil Heat Exchangers Emergency Diesel Generator Jacket Water Cooler Heat Exchangers

Notes:

1. For some of the piping systems, the ISI Program scope includes only safety-related portions of the system, not the entire system.

2. Valves are line-mounted and their "supports" are not included in the scope of this report.

3. The portions of the main steam and feedwater systems inside containment and between containment and the main stream and feedwater isolation valves are included in the ISI Class 2 Program. The portions of each system outboard of these isolation valves up to the "K" line in the Turbine Building are included in the augmented ISI program.

Table 5-2

ASME Code Section XI Subsection IWF
Component Support Structural Integrity Acceptance Standards

From Paragraph IWF-3410
(1983 Edition with Summer 1983 Addenda):

(a) Component support conditions which are unacceptable for continued service shall include the following:

(1) deformations or structural degradations of fasteners, springs, clamps, or other support items;

(2) missing, detached, or loosened support items;

(3) arc strikes, weld splatter, paint, scoring, roughness, or general corrosion on close tolerance machined or sliding surfaces;

(4) fluid loss beyond specified limits or lack of fluid indication (hydraulic snubbers only);

(5) improper hot or cold position (snubbers and spring supports).

(b) Except as defined in (a) above, the following are examples of nonrelevant conditions:

(1) fabrication marks (e.g., from punching, layout, bending, rolling, and machining);

(2) chipped or discolored paint;

(3) weld spatter on other than close tolerance machined or sliding surfaces;

(4) scratches and surface abrasion marks;

(5) roughness or general corrosion which does not reduce the load bearing capacity of the support;support;

(6) general conditions acceptable by the material, Design, and/or Construction Specifications.

(c) Component supports whose examinations reveal conditions as defined in (a) above shall be unacceptable for continued service until they have been replaced or repaired to meet the acceptance standards found in this Article, or have been demonstrated to meet functional requirements through testing or evaluation.

Table 5-3
Systems Included in the Snubber Visual Inspection Surveillance

Class	Systems Included in the CCNPP Snubber Visual Inspection Surveillance
Inside Containment	Service Water Cooling Auxiliary Feedwater NSSS Sampling Chemical and Volumne Control Feed Water Safety Injection Containment Spray Reactor Coolant (Note 1) Spent Fuel Pool Cooling Main Steam
Outside Containment	Service Water Cooling Salt Water Cooling Component Cooling Water Emergency Diesel Generators Auxiliary Steam Chemical and Volume Control Feed Water Safety Injection Containment Spray Spent Fuel Pool Cooling Main Steam (Note 2)

Notes:

1. The Reactor Coolant System snubbers include those for the steam generator and reactor coolant pump motors. These snubber supports are similar to the snubber supports used for RCS piping.

2. The Auxiliary Steam System contains several piping segments adjacent to the Main Steam System which are safety-related (pressure boundary) and are supported by safety-related snubbers. Per the System Level Scoping Results, these segments are considered part of the Main Steam System for IPA evaluations. Likewise the Auxiliary Steam System snubbers are included with the Main Steam System in this table.

Section 6

EVALUATION RECOMMENDATIONS

This section describes the process for determining recommended actions for each component support type and gives the recommended actions for aging management of component supports. The evaluation process is shown in Figure 6.1 and the aging management recommendations are presented by component support type in Table 6-1.

The aging management of component supports for License Renewal has two parts. The first part is a baseline inspection in the Integrated Plant Assessment (IPA) of the component support types to (1) identify active age-related degradation mechanisms (ARDMs), and (2) implement appropriate actions for aging management. The second part consists of the ongoing activities for aging management such as future ISI inspections and the System Engineer walkdowns.

The following inspections are judged to be adequate for the IPA baseline:

- Component support inspections in the SVP and ISI Programs.
- A walkdown, in addition to the SVP and ISI walkdowns, of other supports in the same component type class, during which one or more active ARDMs was found. An example is the walkdowns by a System Engineer for equipment on elastomer vibration isolators, which found active degradation for some supports within the type, but not for other supports. The SVP walkdowns later confirmed these findings. The supports not inspected by SVP, therefore, were judged to be adequately covered by the walkdown.
- A sampling walkdown of component supports with the specific objective of assessing and documenting whether specific potential ARDMs are active for that component support type. Sampling walkdowns are recommended below for component supports for which no credit is taken for the IPA based on the SVP, ISI, or other inspection.

The evaluation process for determining whether the existing aging management of component supports is sufficient for License Renewal consists of the following steps as shown in Figure 6.1 for each component support type:

- The first step is to determine whether all the supports within a component support type are covered by ISI or SVP. This determination is documented in Table 3-1. If all the supports are covered by at least one of these programs, no additional action is required

(beyond the ongoing activities including System Engineer walkdowns). If all the supports are not covered, additional evaluation is required.

- The next step is to determine whether any of the potential ARDMs, documented in Table 2-1, have been confirmed to be active. If no potential ARDMs have been confirmed to be active, a determination is made as to whether a sample of component supports within the component support type was covered by the SVP and ISI (as shown in Table 3-1) and whether the SVP and ISI inspections were sufficient to detect active ARDMs. If there is at least partial coverage and the inspections are judged to be sufficient to detect active ARDMs, a check is made to see if there are any exceptions (e.g., determine whether there are component supports that are different from the majority of the component supports within the component support type). If there are no significant exceptions, no additional action is required. If there are exceptions, a baseline walkdown for "exception" components supports is recommended.

- The next step addresses the remaining component support types that are not covered by ISI or SVP. At this point in the evaluation there are two categories of component support types remaining as follows:

  - Those for which potential ARDMs have been confirmed to be active.

  - Those for which potential ARDMs could not be confirmed to be active and where the ISI and SVP coverage was not judged to be sufficient to determine if active ARDMs exist. Since active ARDMs have not been ruled out at this point, the conservative approach is to assume there are active ARDMs.

For these two categories listed above, a determination is made as to whether (1) the supports are easily accessible for the System Engineer walkdowns and (2) these walkdowns found age-related degradation prior to the discovery by the SVP or ISI of component support degradation. Component supports in most systems outside containment are judged to be easily accessible, while component supports in systems inside containment are not considered easily accessible. If the component supports are easily accessible and component support degradation was found by a System Engineer walkdown prior to SVP or ISI, no additional action is required. Past experience in finding degradation demonstrates that the current system of plant walkdowns can discover the degradation of concern. However, if the component supports are not easily accessible or there is no documentation of degradation being found during a System Engineer walkdown, additional evaluation is required. In the instances where the current system of walkdowns has not found degradation, the conclusion can be that

either no degradation exists, or that it does exist but it is not being discovered. The conservative approach is to assume the latter.

- The last step is to determine whether there is a way, other than SVP, ISI, or an earlier System Engineer walkdown, to take credit for IPA baseline (i.e., confirmation there are no active ARDMs). If there is no other way to take credit for the IPA baseline, additional action is recommended.

The implementation of the process for determining recommended actions for each component support type resulted in three types of recommendations:

- No additional action required—in this case the component support type coverage by SVP and ISI is considered sufficient for the IPA baseline. Only the ongoing actions, including the System Engineer walkdowns, ISI in some cases, Surveilance Inspections in some cases and Vibration Monitoring in some cases are required for aging management for License Renewal. The following component support types fall into this recommendation:

P-1-A	Piping Hangers/Supports Outside Containment (Snubber Supports Only)
P-1-B	Piping Hangers/Supports Inside Containment (Snubber Supports Only)
P-2-A	Piping Frames Outside Containment
C-1-A	Cable Raceway Supports Outside Containment
C-1-B	Cable Raceway Supports Inside Containment
H-1-A	HVAC Ducting Supports Outside Containment
E-1	Equipment with Elastomer Isolators (All are Outside Containment)
E-3	Equipment with Insulation in the Anchorage Load Path
E-4-A	Equipment Frames for Instruments on Racks and Batteries on Racks Outside Containment
E-5-A	Frames & Saddles for Tanks and Heat Exchangers Outside Containment
E-5-B	Frames & Saddles for Tanks and Heat Exchangers Inside Containment
E-6-A	Equipment Metal Spring Isolators & Fixed Bases fo. Pumps, Fans, Air handlers, Chillers, Air Compressors, M-G Sets, and EDGs Outside Containment
E-6-B	Same as E-6-A except Inside Containment
E-7	Equipment LOCA Restraints for Pressurizer and Reactor Coolant Pumps
E-8	Equipment Ring Foundations for Flat-bottomed Vertical Tanks Outside Containment

- Baseline walkdown recommended for "exception" component supports—in this case the vast majority of the supports within a component support type are considered to meet the IPA baseline even though the ISI or SVP scope only includes a portion of the component supports within the component support type. Extending the results of the partial ISI and SVP coverage to the entire population is generally justified because the component supports are similar and their environment and potential ARDMs are the same. However, there are a few component supports that are judged to be sufficiently different from the rest of the component support types. Therefore, extrapolation is not justified, and additional baseline walkdowns are recommended. This situation applies to the following component support type:

  E-2-A Electrical Cabinet Anchorage for MCCs, SWGR, Distribution Panels, Control Panels Outside Containment

- Sampling baseline walkdown of the component supports recommended for some WSLR systems—in this case the component support types were not covered, or only partially covered by SVP and ISI, and there are exceptions within the component support type that prevent extrapolating the ISI and SVP results to the rest of the component supports. This situation applies to the following component support types:

  P-1-A Piping Hangers/Supports Outside Containment (except snubber supports)
  P-1-B Piping Hangers/Supports Inside Containment (except snubber supports)
  P-2-B Piping Frames Inside Containment
  H-1-B HVAC Ducting Supports Inside Containment
  E-2-B Equipment Electrical Cabinet Anchorage for MCCs, SWGR, Distribution Panels, Control Panels Inside Containment
  E-4-B Equipment Frames for Instruments on Racks Inside Containment

  Note that, except for piping hangers/supports outside containment (P-1-A), all of these component support types are inside containment and not easily accessible. The recommendations in Table 6-1 for sampling walkdown inspections of P-1-A component supports are provided on a system, rather than a component support type basis. Piping hangers/supports did not lend themselves as well to the commodity approach. Specifically, the potential ARDMs of loading due to hydraulic vibration or thermal expansion are active for some systems (generally high energy systems), but not for other systems (generally "cold" systems).

One additional general recommendation for ongoing aging management of component supports is to make the the SVP walkdown packages available to the appropriate System Engineers. These packages include field notes and photographs that would facilitate assessments of future component support as-found conditions. CCNPP plans to image all SVP packages and make them available via the NUCLEIS/NORMs database system.

Table 6-1

Recommended Actions for Aging Management of Component Supports

Component Support Type Number	Component Support Type	Recommended Actions (Beyond the Follow-On Activities Discussed in Sections 4 and 5)
P-1-A	Spring Hangers, Constant Load Supports, Sway Struts, Rod Hangers & Snubber Supports/ Outside Containment	Action: Perform a sampling baseline walkdown of the condition of the piping hangers for 8 of the 18 WSLR piping systems outside containment (Well & Pretreated Water, Fire Protection, Compressed Air, Diesel Oil, Plant Heating, Demin. Water & Cond. Storage, Sampling System (NSSS), and Condensate). The walkdown scope should include inspection, on a sampling basis, for corrosion and loose bolts, and should be documented by field notes and photographs, if possible. Subsequent walkdowns (beyond the System Engineer required walkdowns) would not be required if no active ARDMs are found to exist during the baseline walkdowns. If piping hangers in any system are found to have an active corrosion mechanism, however, the baseline inspection scope for that system should be expanded to include frame type piping supports (Component Support Type P-2-A). Basis: From Table 3-1, piping hanger supports for 10 of the 18 WSLR systems located outside containment are included in ISI program inspections. 8 WSLR systems are not covered by ISI. From Table 2-1, potential ARDMs for piping hangers include loading due to hydraulic vibration and thermal growth that could result in loosening of threaded fasteners. ISI inspections occasionally find loose bolts in hangers, which indicates that ARDMs of loading due to hydraulic vibration or due to thermal expansion are active in some systems.
P-1-B and P-2-B	Spring Hangers, Constant Load Supports, Sway Struts, Rod Hangers & Snubber Supports/ Inside Containment and Piping Frames/ Inside Containment	Action: Perform a sampling baseline walkdown of the condition of the piping supports for 3 of the 11 WSLR systems inside containment (Fire Protection, Compressed Air, and Sampling System (NSSS)). The walkdown scope should include inspection, on a sampling basis, for corrosion and loose bolts (for piping hanger supports), and should be documented by field notes and photographs, if possible. Subsequent walkdowns (beyond the System Engineer required walkdowns) would not be required if no active ARDMs are found to exist during the baseline walkdowns. Basis: From Table 3-1, piping supports for 8 WSLR systems located inside containment are included in ISI program inspections. There are, however, 3 WSLR systems that are not included in ISI, and are not routinely walked down due to their location inside containment. From Table 2-1, potential ARDMs for piping hangers include loading due to hydraulic vibration and thermal growth that could result in loosening of threaded fasteners. ISI inspections occasionally find loose bolts in hangers, which indicates that ARDMs of loading due to hydraulic vibration or due to thermal expansion are active in some systems. Also, the potential ARDM for corrosion of piping supports is more likely to be active inside containment, than outside containment.

Table 6-1 (Continued)

Recommended Actions for Aging Management of Component Supports

Component Support Type Number	Component Support Type	Recommended Actions (Beyond the Follow-On Activities Discussed in Sections 4 and 5)
P-2-A	Piping Frames/ Outside Containment	Action: No additional action required. Basis: From Notes 9 and 10 in Table 2-1, the potential ARDMs which result in loosened threaded fasteners, do not apply to frame type supports. If an active corrosion mechanism is found during the recommended sampling baseline walkdowns for pipe hangers outside containment (see P-1-A), then the inspection scope for that system would be expanded to piping frame supports.
C-1-A	Channel, Clamp & Other Supporting Styles/ Outside Containment	Action: No additional action required. Basis: From Table 3-1, all cable raceways in the Auxiliary Building, Intake Structure and part of the Turbine Building were walked down during SVP, and no active ARDMs were identified. The raceway supports in the portion of the Turbine Building that were not formally walked down are constructed of the same materials and exposed to roughly the same environment as those in the Auxiliary Building. It is judged, therefore, that the Turbine Building raceway supports are covered for aging management by the SVP walkdowns of the Auxiliary Building raceways and Follow-On activities discussed in Section 4.
C-1-B	Channel, Clamp & Other Supporting Styles / Inside Containment	Action: No additional action required. Basis: All cable raceways in the Unit 1 and 2 Containments were walked down during the SVP, and no active ARDMs were identified.
H-1-A	Rod Hanger, Trapeze Supports/ Outside Containment	Action: No additional action required. Basis: HVAC ducting is outside the scope of the SVP and ISI programs. Ducting supports located outside containment, however, are constructed of the same materials as some raceway supports, and are located in the same building areas as the raceways that were walked down during SVP. Since no active ARDMs were noted for the raceway supports (duct supports and raceway supports have the same potential ARDMs), it is judged that HVAC ducting supports are covered for aging management by the SVP walkdowns of cable raceway supports outside containment, and Follow-On activities discussed in Section 4.

Table 6-1 (Continued)

Recommended Actions for Aging Management of Component Supports

Component Support Type Number	Component Support Type	Recommended Actions (Beyond the Follow-On Activities Discussed in Sections 4 and 5)
H-1-B	Rod Hanger, Trapeze Supports/ Inside Containment	Action: Perform a sampling baseline walkdown of the condition of the ducting supports for the WSLR HVAC system inside containment (Primary Containment H & V). The walkdown scope should include inspection, on a sampling basis, for corrosion, and should be documented by field notes and photographs, if possible. Subsequent walkdowns (beyond the System Engineer required walkdowns) would not be required if no active ARDMs are found to exist during these walkdowns. Basis: Ducting supports are not included in either the ISI or SVP program inspections, and ducting supports inside containment are not routinely walked down. From Table 2-1, potential ARDMs for ducting supports inside containment are those associated with corrosion, which is more likely to be active inside containment, than outside containment.
E-1	Anchorage Including Elastomer Vibration Isolators (for Fans, Compressors, Chillers, & Air Handlers)/ Outside Containment	Action: Replace isolators (as planned) for CR HVAC air handler. Basis: From Table 3-1, most of the equipment items outside containment that include elastomer vibration isolators were included in SVP. From Table 2-1, potential ARDMs for elastomer vibration isolators include hardening of the elastomer material. The SVP program found the current condition of vibration isolators inspected to be acceptable, except for those which support the CR HVAC air handler. Prior to the SVP walkdown, these supports had been identified by the system engineer as requiring replacement, and a modification had been planned to replace the elastomer isolators with spring-type isolators. (This modification has not been made as of the date of this report.) After the isolators are replaced, the routine walkdowns by System Engineers are judged to be adequate to manage aging of elastomer isolator component supports outside containment.

Table 6-1 (Continued)

Recommended Actions for Aging Management of Component Supports

Component Support Type Number	Component Support Type	Recommended Actions (Beyond the Follow-On Activities Discussed in Sections 4 and 5)
E-2-A	Electrical Cabinet Anchorage (MCCs, SWGR, Distribution Panels, Control Panels)/ Outside Containment	Action: No additional action required, except for the cabinet anchorage for Sampling System (NSSS) "hoods." A baseline walkdown of the condition of the anchorage for the sampling hoods in this system is recommended. The walkdown scope should include inspection for corroded anchor bolts, and should be documented by field notes and photographs, if possible. Subsequent walkdowns (beyond the System Engineer required walkdowns) would not be required for sampling hoods whose anchorage is not corroded. Basis: From Table 3-1, a majority of WSLR systems outside containment with electrical and non-electrical (e.g., process control) cabinet anchorage were included in SVP. From Table 2-1, corrosion is a potential ARDM. Except for the sampling hoods in the Sampling System (NSSS), the SVP walkdowns found no evidence that corrosion is an active ARDM for cabinet anchorage outside containment. In the two sampling hoods included in SVP, however, significant corrosion was found on the cabinet anchorage. Although these cabinets were judged to have adequate capacity for their design loads at the time of inspection, there is a concern that the condition of these anchorages will deteriorate to an unacceptable level in the future, and that other sampling hoods in this system may also have an active corrosion mechanism. Therefore, baseline inspections are recommended for cabinets in the Sampling System.
E-2-B	Electrical Cabinet Anchorage (MCCs, SWGR, Distribution Panels, Control Panels)/ Inside Containment	Action: Perform a baseline walkdown of the condition of the anchorage for the six WSLR radiation monitors inside containment (Area and Process Radiation Monitoring System). The walkdown scope should include inspection for corrosion, and should be documented by field notes and photographs, if possible. Subsequent walkdowns (beyond the System Engineer required walkdowns) would not be required if no active ARDMs are found to exist during these walkdowns. Basis: From Table 3-1, anchorages for the six WSLR radiation monitors located inside containment are not included in SVP inspections, and they are not routinely walked down due to their location inside containment. From Table 2-1, the potential ARDM for corrosion of cabinet anchorage is more likely to be active inside containment, than outside containment.

Table 6-1 (Continued)

Recommended Actions for Aging Management of Component Supports

Component Support Type Number	Component Support Type	Recommended Actions (Beyond the Follow-On Activities Discussed in Sections 4 and 5)
E-3	Electrical Equipment That May Include Insulation Material in Anchorage Load Path (Transformers, Battery Chargers, Inverters)/ Outside Containment	Action: No additional action required. Basis: From Table 3-1, most of the WSLR system the electrical equipment WSLR that may include insulation material in the load path was included in SVP. From Table 2-1, potential ARDMs for this component support type include degradation of the insulating material included in the load path between the transformer coil, and base anchorage. Degradation of the insulating material would not be detectable by visual inspection techniques for this component support type. However, insulating material in the load bearing path contributes minimally to the structural support function and hardening of such material occurs gradually over time. In order for degradation of the insulating material to impact the structural support function, it would have had to progress far beyond the point where it would have caused failure of the active intended function of the electrical equipment. Therefore, programs (independent of license renewal) which maintain operability of active electrical equipment will ensure that aging of such insulating material could not affect the intended structural support function and no follow-on activities are necessary to manage the effects of this type of aging on the structural integrity function.
E-4-A	Equipment Frames (Instr. on Racks & Batteries on Racks)/ Outside Containment	Action: No additional action required. Basis: From Table 3-1, many WSLR systems outside containment with frame-type supports for instruments and batteries were included in SVP. From Table 2-1, corrosion is a potential ARDM. In walkdowns of over 300 instruments on racks, the SVP program found no evidence that corrosion is an active ARDM for this component support type outside containment. The frame-type supports for instruments that were not included in SVP are therefore judged to be covered for aging management baseline inspection by the SVP walkdowns of those that were included, and by the Follow-On activities discussed in Section 4.

Table 6-1 (Continued)

Recommended Actions for Aging Management of Component Supports

Component Support Type Number	Component Support Type	Recommended Actions (Beyond the Follow-On Activities Discussed in Sections 4 and 5)
E-4-B	Equipment Frames (Instr. on Racks)/ Inside Containment	Action: No additional action required. Basis: Instrument supports for a representative sample of WSLR systems located inside containment are included in the SVP. The frame type supports for instruments in containment are similar in materials and environment to many of those inspected by SVP outside containment. Additionally, concrete expansion anchor bolt tightness check inspections were performed for 4 instruments on racks in the Unit 1 containment (2 in Main Steam System, and 2 in Reactor Coolant System), as part of the SVP program. No significant aging concerns were identified during either of these inspection activities. Due to the number and variety of supports of this type inspected by SVP outside containment and the checks performed of some supports inside Containment, the frame type supports that were not included in the SVP inside containment are judged to be adequately covered for aging management baseline inspection.
E-5-A	Frames & Saddles (Tanks & HXs)/ Outside Containment	Action: No additional action required. Basis: From Table 3-1, tank and heat exchanger supports for most of the WSLR systems located outside containment are included in SVP or ISI. From Table 2-1, potential ARDMs for tank and heat exchanger supports include loading due to hydraulic vibration and thermal growth that could result in degradation of the design features intended to accommodate these motions. The SVP walkdowns did not identify any active ARDMs for the component supports inspected.
E-5-B	Frames & Saddles (Tanks & HXs)/ Inside Containment	Action: No additional action required. Basis: From Table 3-1, tank and heat exchanger supports for most of the WSLR systems located inside containment are included in SVP. From Table 2-1, potential ARDMs for tank and heat exchanger supports include loading due to hydraulic vibration and thermal growth that could result in degradation of the design features intended to accommodate these motions. The SVP walkdowns did not identify any active ARDMs for the component supports inspected. Of the WSLR tanks and heat exchangers not inspected (the safety injection tanks and the hydrogen recombiner), it is judged that there is little likelihood of these components having an active ARDM due to hydraulic vibration or thermal expansion. The SVP and Follow-On activities discussed in Section 4 are judged adequate to manage aging for these component supports.

Table 6-1 (Continued)

Recommended Actions for Aging Management of Component Supports

Component Support Type Number	Component Support Type	Recommended Actions (Beyond the Follow-On Activities Discussed in Sections 4 and 5)
E-6-A	Metal Spring Isolators & Fixed Bases (Pumps, Fans, Air Handlers, Chillers, Air Compressors, M-G Sets, EDGs)/ Outside Containment	Action: No additional action required. Basis: From Table 3-1, more than half of the mechanical components with spring isolators or fixed bases in WSLR systems outside containment were included in SVP. From Table 2-[illegible], potential ARDMs for these component supports include local deterioration of grout/concrete, and loading due to rotating/reciprocating machinery. The SVP inspections, however, did not identify any active ARDMs for the supports inspected. It is judged that the spring isolator and fixed base supports for WSLR systems outside containment that were not inspected, are no more likely to have active ARDMs than the ones that were inspected. Therefore, it is concluded that aging of these supports is adequately managed by SVP and by Follow-On activities (including the CCNPP vibration monitoring program) discussed in Section 4.
E-6-B	Metal Spring Isolators & Fixed Bases (Pumps, Fans, Air Handlers, Chillers, Air Compressors, M-G Sets, EDGs)/ Inside Containment	Action: No additional action required. Basis: From Table 3-1, there are no components with metal spring isolators or a fixed base in a WSLR system inside containment except for the containment cooler fans, which are included in SVP, and the Reactor Coolant Pumps, which are included in component support type E-7 (LOCA Restraints).
E-7	LOCA Restraints (PZR & RC Pump)/ Inside Containment	Action: No additional action required. Basis: From Table 3-1, the only components whose supports include LOCA restraints that are included in WSLR systems (and are within the scope of this report) are the Reactor Coolant Pumps and the Pressurizer. The supports for these components are included in the ISI Class 1 Program. Therefore, their aging is adequately managed.
E-8	Ring Foundation for Flat-bottom Vertical Tanks	Action: No additional action required. Basis: From Table 3-1, all 9 WSLR flat-bottom vertical tanks on concrete ring foundations are included in SVP. All 9 tank anchorages were evaluated for seismic adequacy as part of the SVP program. Some of these tanks had radial cracks in the concrete rings, but the impact of these cracks on the structural adequacy of the anchorage was judged to be insignificant in the SVP evaluations. Additional action (beyond system engineer walkdowns), therefore, is not required.

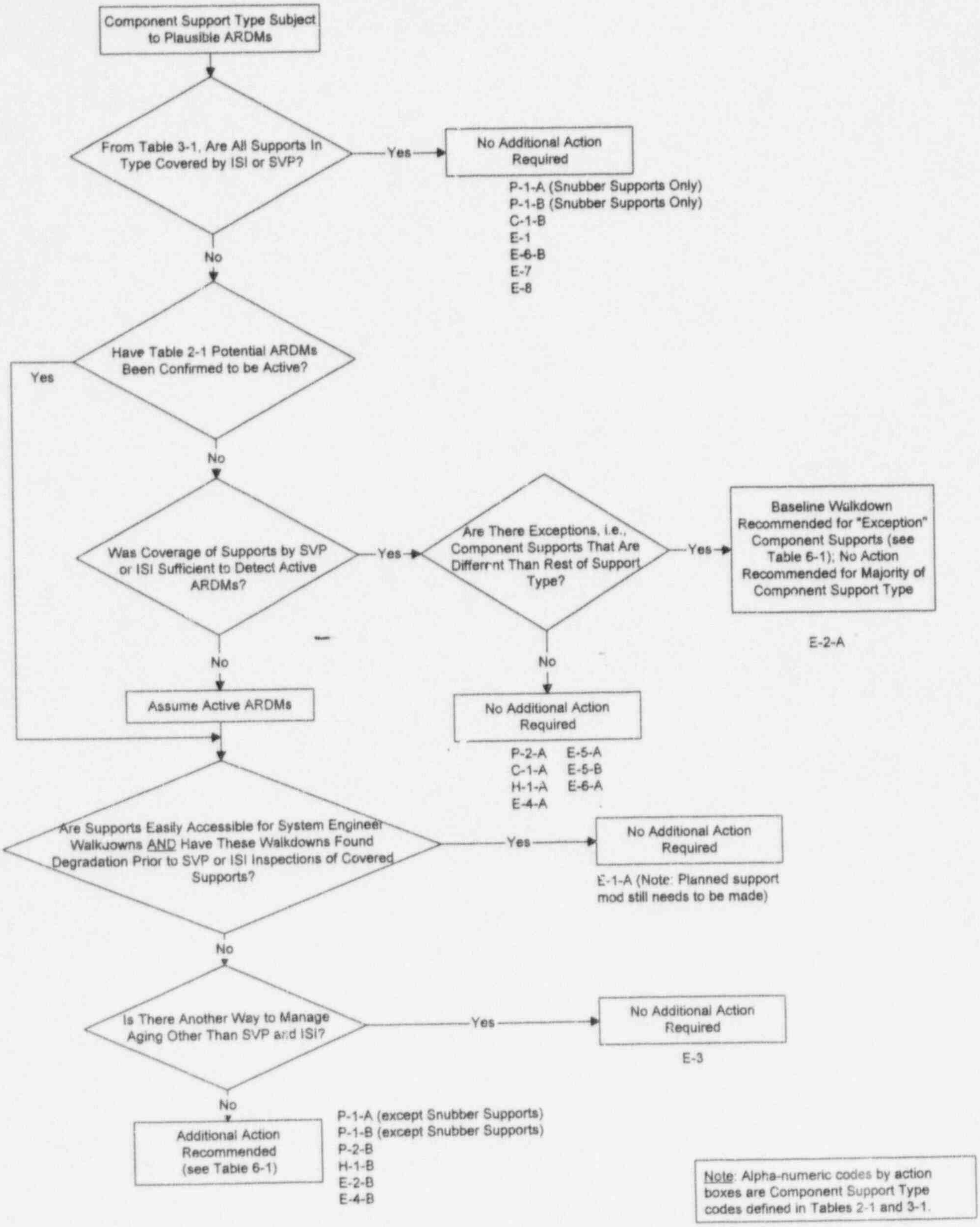

Figure 6.1. Process for Determining Recommended Actions for Each Component Support Type

Section 7

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Appendix A

SQUG EARTHQUAKE EXPERIENCE DATABASE FACILITIES' APPROXIMATE AGE AT TIME OF CONDITION REVIEW

SQUG Earthquake Experience Database Facilities' Approximate Age at Time of Condition Review[1]

Facility	Approximate Year of Construction	Year of Earthquake and review of Post-Earthquake Condition	Approx. Age of Equipment at Time of Condition Review (Years)
Sylmar Converter Station	1971	1971	New
Rinaldi Receiving Station	1968	1971	3
Valley Steam Plant	1954, 1954, 1955, 1956	1971	17, 17, 16, 15
Burbank Power Plant	1958, 1961	1971	13, 10
Glendale Power Plant	1941, 1947, 1953, 1959, 1964	1971	30, 24, 18, 12, 7
Pasadena Power Plant	1955, 1957, 1965	1971	16, 14, 6
Ormond Beach Power Plant	1970, 1973	1973	3, New
Goleta Substation	Unknown	1978	Unknown
Drop IV Hydroelectric Plant	1941, 1950	1979	38, 29
Humboldt Bay Power Plant	1954, 1958	1980	26, 22
Main Oil Pumping Plant	Unknown	1983	Unknown
Union Oil Butane Plant	1946, 1981	1983	35, 2
Shell Water Treatment Plant	1981	1983	2
Coalinga Water Treatment Plant	Unknown	1983	Unknown
Coalinga Substation No. 2	1920's	1983	55
Shell Tank Farm No. 29	Unknown	1983	Unknown
Pleasant Valley Pumping Plant	1969	1983	14
San Luis Canal Pumping Stations	Unknown	1983	Unknown
Gates Substation	1950's, 1960's	1983	30, 20
Kettleman Compressor Station	1950's	1983	30
United Tech. Chemical Plant	Unknown	1984	Unknown
IBM/Santa Teresa Facility	Mid-1970's	1984	10
San Martin Winery	1930's, 1970's	1984 (& 1989)	50, 10

SQUG Earthquake Experience Database Facilities' Approximate Age at Time of Condition Review[1]

Facility	Approximate Year of Construction	Year of Earthquake and review of Post-Earthquake Condition	Approx. Age of Equipment at Time of Condition Review (Years)
Wiltron Electronics Plant	Unknown	1984	Unknown
Metcalf Substation	Unknown	1984	Unknown
Evergreen Community College	Unknown	1984	Unknown
Mirassou Winery	1930's, 1940's, 1970's	1984	50, 40, 10
Bata Shoe Factory	1961	1985	24
San Isidro Substation	Unknown	1985	Unknown
Llolleo Water Pumping Plant	1953	1985	32
Terquim Tank Farm	Unknown	1985	Unknown
Vicuna Hospital	Unknown	1985	Unknown
Rapel Hydroelectric Plant	1968, 1969, 1970	1985	17, 16, 15
San Sebastian Substation	Unknown	1985	Unknown
Concon Petroleum Refinery	1952+	1985	≤33
Oxiquim Chemical Plant	1955+	1985	≤30
Concon Water Pumping Station	1910, 1963	1985	75, 22
Renca Power Plant	1962	1985	23
Laguna Verde Power Plant	1932, 1949	1985	53, 36
Las Ventanas Copper Refinery	Unknown	1985	Unknown
Las Ventanas Power Plant	1964, 1977	1985	21, 8
San Cristobal Substation	Unknown	1985	Unknown
Las Condes Hospital	Unknown	1985	Unknown
Infiernillo Hydroelectric Plant	1960's	1985	20
La Villita Power Plant	1973	1985	12
SICARTSA Steel Mill	Unknown	1985	Unknown
Fertimex Fertilizer Plant	1980's	1985	New

SQUG Earthquake Experience Database Facilities' Approximate Age at Time of Condition Review[1]

Facility	Approximate Year of Construction	Year of Earthquake and review of Post-Earthquake Condition	Approx. Age of Equipment at Time of Condition Review (Years)
Adak Naval Base	1948-1978	1986	38, 8
Devers Substation	1960's, 1970's, 1980's	1986	20, 10, 2
Whitewater Hydroelectric Plant	1985	1986	1
Control Gorge Hydro Plant	Unknown	1986	Unknown
Hi-Head Hydro Plant	1962	1986	24
Soyapango Substation	1953	1986	33
San Antonio Substation	Unknown	1986	Unknown
Power Plant 1	Unknown	1987	Unknown
Power Plant 3	Unknown	1987	Unknown
Edgecumbe Substation	1938, 1950's 1970's	1987	49, 30, 10
New Zealand Distillery	Unknown	1987	Unknown
Caxton Paper Mill	1955+	1987	≤32
Kawerau Substation	1950's, 1970's	1987	30, 10
Whakatane Board Mill	1938, 1955, 1973	1987	49, 32, 14
Matahina Dam	1960's	1987	20
Olinda Substation	Unknown	1987	Unknown
SCE Central Dispatch Headquarters	1930's, 1970's	1987	50, 10
SCE Headquarters (Rosemead)	1970, 1975, 1980	1987	17, 12, 7
California Federal Bank Facility	1982	1987	5
Ticor Facility	1980	1987	7
Mesa Substation	early - 1950's	1987	35
Sanwa Bank Facility	Unknown	1987	Unknown
Alhambra Pacific Bell Station	1930's	1987	50

SQUG Earthquake Experience Database Facilities' Approximate Age at Time of Condition Review[1]

Facility	Approximate Year of Construction	Year of Earthquake and review of Post-Earthquake Condition	Approx. Age of Equipment at Time of Condition Review (Years)
Rosemead Pacific Bell Station	1950's	1987	30
Pacific Bell Central Station	Unknown	1987	Unknown
Wells Fargo Bank Facility	1964, 1980	1987	23, 7
Center Substation	Unknown	1987	Unknown
Del Amo Substation	Unknown	1987	Unknown
Lighthype Substation	1920's	1987	60
Commerce Refuse-to-Energy Plt	1985	1987	2
Puente Hills Landfill Gas & Energy Recovery Plant	1986	1987	1
Mesquite Lake Resource Recovery Plant	1987	1987	New
El Centro Steam Plant	1949, 1952, 1957, 1968	1987	38, 35, 30, 19
A. D. Edmonston Pump Plant	Unknown	1988	Unknown

Notes: (1) This table includes facilities listed in Table 1 of Reference 4.2.

Appendix B

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