VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

10 CFR 50
10 CFR 51
10 CFR 54

June 10, 2019

United States Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555-0001

Serial No.:	19-248
NRA/DEA:	R2'
Docket Nos.:	50-280/281
License Nos.:	DPR-32/37

VIRGINIA ELECTRIC AND POWER COMPANY
SURRY POWER STATION (SPS) UNITS 1 AND 2
SUPPLEMENT TO SUBSEQUENT LICENSE RENEWAL APPLICATION
CHANGE NOTICE 3

By letter dated October 15, 2018 (Agencywide Documents Access and Management System (ADAMS) Package Accession No. ML18291A842), Virginia Electric and Power Company (Dominion Energy Virginia) submitted an application for the subsequent license renewal of Renewed Facility Operating License Nos. DPR-32 and DPR-37 for the Surry Power Station.

The purpose of this letter is to update the SLRA to incorporate changes discussed with NRC staff during recent NRC onsite audits, document MRP 227-A, Revision 1 updates and update other editorial items.

Enclosure 1 provides descriptions of ten topics that require a SLRA supplement and identifies each affected SLRA section and/or table. Enclosure 2 includes mark-ups of each affected SLRA section and/or table being supplemented, as described in Enclosure 1. It should be noted that changes to two commitments (Items #16 and #34) are provided in Table A4.0-1.

A035
NRR

If there are any questions regarding this submittal or if additional information is needed, please contact Mr. Paul Aitken at (804) 273-2818.

Sincerely,

Mark D. Sartain
Vice President - Nuclear Engineering and Fleet Support

DIANE E. AITKEN
NOTARY PUBLIC
REG. #7763114
COMMONWEALTH OF VIRGINIA
MY COMMISSION EXPIRES MARCH 31, 2022

COMMONWEALTH OF VIRGINIA)
)
COUNTY OF HENRICO)

The foregoing document was acknowledged before me, in and for the County and Commonwealth aforesaid, today by Mark D. Sartain, who is Vice President - Nuclear Engineering and Fleet Support of Virginia Electric and Power Company. He has affirmed before me that he is duly authorized to execute and file the foregoing document in behalf of that Company, and that the statements in the document are true to the best of his knowledge and belief.

Acknowledged before me this 10 day of June, 2019.

My Commission Expires: March 31, 2022

Diane E. Aitken
Notary Public

Commitments made in this letter:

The Licensee Commitments identified in Table A4.0-1 of Appendix A, Final Safety Analysis Report Supplement, are proposed to support approval of the subsequent renewed operating licenses and may change during the NRC review period.

Enclosures:

Enclosure 1 – Topics that Require a SLRA Supplement

Enclosure 2 – SLRA Mark-ups - Change Notice 3

cc: (w/o Enclosures except *)

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Enclosure 1

TOPICS THAT REQUIRE A SLRA SUPPLEMENT

Virginia Electric and Power Company
(Dominion Energy Virginia)
Surry Power Station Units 1 and 2

The following ten topics require the SLRA to be supplemented:

1. Components Supports and NSSS Fatigue TLAA AMR Lines
2. Aging Management of Neutron Shield Tank
3. Fire Protection and Domestic Water Tank Foundation Aging Management
4. Pressure-Temperature Limits (Section 4.2.5): TLAA Evaluation Editorial Correction
5. 10 CFR Part 50, Appendix J program (B2.1.32): UFSAR Supplement Revision
6. *Fire Water System* program (B2.1.16): Enhancement Clarified, Operating Experience Update, Program Description Revision, and UFSAR Supplement Revisions
7. *Masonry Walls* program (B2.1.33): Enhancement Revision
8. *Structures Monitoring* program (B2.1.34): Program Description Revision, UFSAR Supplement Revision, and Enhancements Revised/Added
9. Appendix C – MRP-227-A Gap Analysis for PWR Vessel Internals Aging Management: GAP Analysis Tables Clarification /Revision
10. Further Evaluation of Aging Management Associated With Increase in Porosity and Permeability Due to Leaching of Calcium Hydroxide and Carbonation in Inaccessible Concrete Areas

The following ten topics require the SLRA to be supplemented:

1. Component Supports and NSSS Supports Fatigue TLAA AMR Lines

A fatigue TLAA was inadvertently identified for structural members associated with Component Supports and NSSS Supports in SLRA Section 3.5.2.2.2.5; and Tables 3.5.1, 3.5.2-36 and 3.5.2-38. Further review has confirmed that there are no TLAAs associated with Component Supports and NSSS Supports.

Based on the above, the SLRA is supplemented as shown in Enclosure 2, to clarify that there are no fatigue TLAAs associated with Component Supports and NSSS Supports in the following:

SLRA Section	SLRA Table
3.5.2.2.2.5	3.5.1
	3.5.2-36
	3.5.2-38

2. Aging Management of Neutron Shield Tank

The *External Surfaces Monitoring of Mechanical Components* program was assigned to manage loss of material for the external surfaces of the neutron shield tank. However, it was deemed more appropriate for the *Structures Monitoring* program to manage this aging effect. In addition, SLRA Section 2.4.1.38 (NSSS Supports) is updated to clarify that the neutron shield tank is evaluated with the reactor coolant system.

Based on the above, the SLRA is supplemented as shown in Enclosure 2, in the following:

SLRA Section	SLRA Table
2.4.1.38	3.1.2-3
3.1.2.1.3	3.5.1

3. Fire Protection and Domestic Water Tank Foundation Aging Management

Operating experience identified degradation of the oiled-sand cushion beneath the fire protection/domestic water tank foundations. Loss of material and loss of form of the earthfill material (oiled-sand cushion) beneath the fire protection/domestic water tank foundations will be managed by the *Structures Monitoring* program (B2.1.34).

Based on the above, the SLRA is supplemented as shown in Enclosure 2, to incorporate management of the oiled-sand cushion beneath the fire protection/domestic water tank foundations in the following:

SLRA Sections	SLRA Tables
2.4.1.27	2.4.1-27
3.5.2.1.27	3.5.1-058
	3.5.2-27

4. Pressure-Temperature Limits (Section 4.2.5): TLAA Evaluation Editorial Correction

An editorial correction is made to the fifth paragraph of the TLAA Evaluation in Section 4.2.5 to specify the nozzle forging materials are documented in Tables 4.2.4-1, 4.2.4-3, 4.2.4-5, and 4.2.4-7.

Based on the above, Section 4.2.5 is supplemented, as shown in Enclosure 2, to specify the nozzle forging materials are documented in Tables 4.2.4-1, 4.2.4-3, 4.2.4-5, and 4.2.4-7.

5. 10 CFR Part 50, Appendix J program (B2.1.32): UFSAR Supplement Revision

The *10 CFR Part 50, Appendix J* program UFSAR Supplement is revised to include "subject to the requirements of 10 CFR Part 54" to be consistent with the NUREG-2191 Table X1-01, "FSAR Supplement Summaries for GALL-SLR Chapter XI Aging Management Programs."

SLRA Section A1.32 is supplemented, as shown in Enclosure 2, to include the UFSAR Supplement revision described above.

6. *Fire Water System* program (B2.1.16): Enhancement Clarified, Operating Experience Update, Program Description Revision, and UFSAR Supplement Revisions

The *Fire Water System* program revision includes the following items:

- Exception #1 is deleted with the commitment to permanently remove the exterior insulation of fire protection/domestic water tanks (a.k.a. fire water storage tanks).
- Enhancement #7 is revised as follows:
  Prior to the subsequent period of extended operation, the insulation on the exterior surfaces of the fire water storage tanks (FWSTs) will be permanently

removed. Wall thickness measurements will be performed on external tank areas exhibiting unexpected degradation. Refurbishment/recoating will be performed consistent with the severity of the degradation identified and commensurate with the potential for loss of intended function. Inspections of external tank surfaces will be on a refueling cycle frequency.

- Enhancement #11 is revised to require visual inspection and wall thickness examination of the Unit 1 hydrogen seal oil deluge sprinkler piping that does not allow drainage as part of drainage reconfiguration. Wall thickness examination of the Unit 1 main transformer deluge sprinkler piping that does not allow drainage will also be performed as part of the drainage reconfiguration. Piping with unexpected degradation will be replaced.
- Operating experience #6 and #7 for the FWSTs internal inspections results are revised to include August 2018 internal visual inspection results and March 2019 bottom thickness measurements.
- Operating experience #10 for the fire protection system flow test results is revised to present motor driven fire pump and diesel driven fire pump discharge pressure data from the 2014 through 2019 flow tests.

The *Fire Water System* program UFSAR Supplement is revised as follows:

- A cracking aging effect that was not incorporated with SLRA Change Notice #2 is incorporated.
- The following qualification commitment is incorporated and also included in the AMP program description:

  The training and qualification of individuals involved in coating/lining inspections of non-cementitious coatings/linings are conducted in accordance with ASTM International Standards endorsed in RG 1.54 including guidance from the NRC staff associated with a particular standard.

Fire Hydrant flushing procedures were revised to ensure the following information is captured in a condition report when a fire hydrant barrel does not drain in 60 minutes:

> Where soil conditions or other factors are such that a hydrant barrel does not drain within 60 minutes, or where groundwater level is above that of the hydrant drain, the hydrant drain shall be plugged and the water in the barrel shall be pumped out. Dry barrel hydrants that will be subject to freezing weather and have plugged drains shall be identified clearly as needing pumping after operation.

SLRA Section B2.1.16, Section A1.16 and Table A4.0-1, Item 16 are supplemented, as shown in Enclosure 2, with enhancement revisions, operating experience revisions and UFSAR Supplement revisions.

7. *Masonry Walls* program (B2.1.33): Enhancement Revision

The *Masonry Walls* program is revised to apply Enhancement #2 to Element 6, Acceptance Criteria.

SLRA Section B2.1.33 is supplemented, as shown in Enclosure 2, with the enhancement #2 clarification.

8. *Structures Monitoring* program (B2.1.34): Program Description Revision, UFSAR Supplement Revision, and Enhancements Revised/Added

The *Structures Monitoring* program is revised to include the following new enhancements:

- Procedures will be enhanced to specify that evaluation of neutron shield tank findings consider its structural support function for the reactor pressure vessel.
- Procedures will be enhanced to also include LOCAs as events that require evaluation for potentially degraded structures by Civil/Mechanical Design Engineering.
- Procedures will be enhanced to include aging management of erosion for the oiled-sand cushion in the fire protection and domestic water storage tank foundations.

The *Structures Monitoring* program description and UFSAR Supplement are revised to include an aging effect of loss of material and loss of form for aging management of the earthfill material (oiled-sand cushion) beneath the fire protection/domestic water tank foundations.

SLRA Section B2.1.34, Section A1.34 and Table A4.0-1, Item 34 are supplemented, as shown in Enclosure 2, to include the program description and UFSAR Supplement revisions and enhancement revisions/additions described above.

9. Appendix C – MRP-227-A Gap Analysis for PWR Vessel Internals Aging Management: GAP Analysis Tables Clarification/Revision

The following SLRA Appendix C components are supplemented, as shown in Enclosure 2, to incorporate the revisions/clarifications described below. Unless noted otherwise, reference Westinghouse letter AMLR-17-35-P Revision 1 for additional details.

SLRA Appendix C Components Changes or Clarifications

Component	App. C Table (page #)	Description of Change
CRGT Flexures	C3.3-3 (page C-29)	Note #6 was used to reference the Areva evaluation for the Unit 1 (AREVA) flexures to identify Safety and Economic Consequences, FMECA Groups, and Risk Categorization. The SLR Inspection Category remains "N" (No Additional Measures).
Fuel Alignment Pins (Upper)	C3.3-3 (page C-31)	Referred to Note #7 for further explanation of degradation mechanisms for upper fuel alignment pins. Wear-related surface degradation is considered the leading degradation mechanism.
Core Barrel: Core Barrel Flange (Surface)	C3.3-3 (page C-36)	Corrected an editorial error to indicate the SLR Inspection Category is "X" instead of "E".
Core Barrel: Core Barrel Outlet Nozzle	C3.3-3 (page C-36)	Corrected an editorial error to indicate the SLR Inspection Category is "N" instead of "E".
Core Barrel: Lower Axial Weld Lower Flange Weld	C3.3-3 (page C-36)	Corrected an editorial error that originated in Change Notice #2. The lower flange weld was supposed to be removed, and Note #5 added, in Change Notice #2. Instead, the lower axial weld was removed and Note #5 was added. This error has been corrected in Change Notice #3.
Fuel Alignment Pins (Lower)	C3.3-3 (page C-37)	Referred to Note #7 for further explanation of degradation mechanisms for lower fuel alignment pins. Wear-related surface degradation is considered the leading degradation mechanism.
CRGT Flexures	C3.3-3 (page C-41)	Note #6 is added to Table C3.3-3.

Fuel Alignment Pins	C3.3-3 (page C-41)	Note #7 is added to Table C3.3-3.
CRGT Sheaths and C-Tubes	C4.3-1 (page C-54)	Expansion link to the CRGT continuous section sheaths and C-tubes has been added along with Note #18 for associated Primary component CRGT guide plates (cards).
Alignment and Interfacing Components: Clevis insert bolts, Clevis insert dowels; Clevis bearing Stellite wear surface. Radial Support Keys, Stellite wear surfaces.	C4.3-1 (page C-56)	The addition of Note #18 resulted in the previous Note #18 being renumbered to Note #19.
CRGT Guide Cards	C4.3-1 (page C-58)	Revised Note #2 to remove the following sentence: "Interim Guidance issued in PWROG Letter OG 18-76 amends the requirements regarding baseline examinations".
CRGT Sheaths and C-Tubes	C4.3-1 (page C-58)	Note #18 is added to Table C4.3-1.
CRGT Sheaths and C-Tubes	C4.3-2 (page C-59)	Included a new line to identify an Expansion item for "Control Rod Guide Tube Continuous section sheaths and C-tubes"
Core Barrel: Middle Axial Weld Lower Axial Weld Upper Girth Weld	C4.3-2 (page C-59)	For the core barrel assembly, changed Note #9 to Note #8 for the middle axial weld (MAW) and lower axial weld (LAW), and for the upper girth weld (UGW). The reason for the change is the removal of Note #8, and the renumbering of Note #9.
Core Barrel: Lower Flange Weld & Upper Axial Weld	C4.3-2 (page C-60)	For the core barrel assembly, change Note #9 to Note #8 for the lower flange weld (LFW), and for the upper axial weld (UAW). The reason for the change is the removal of Note #8, and the renumbering of Note #9.
Lower Support Forging & Lower Support	C4.3-2 (page C-60)	An error was corrected that originated in Change Notice #2. The correct examination method for the lower support forging and for the lower support column bodies

Column Bodies (cast)		(cast) is VT-3 as indicated in MRP-227, Revision 1, but had been incorrectly changed to EVT-1 in CN#2. Note 5 was added to the Lower Support Column Bodies (cast).
Core Barrel: MAW, LAW, UGW, LFW, UAW	C4.3-2 (page C-61)	Removed Note #8 and renumbered Note #9 to be Note #8.

SLRA Appendix C Gap Analysis changes resulted in aging evaluation changes for the following components:

- Control rod guide tube (CRGT) continuous section sheaths and C-Tubes. An expansion link to the CRGT continuous section sheaths and C-tubes has been added for the associated Primary component CRGT guide plates (cards).
- Core barrel outlet nozzle welds are eliminated as an expansion component in MRP-227, Revision 1.

Based on the above, the SLRA is supplemented as shown in Enclosure 2, to revise aging evaluation for the CRGT continuous section sheaths and C-tubes and the core barrel outlet nozzle welds in the following:

SLRA Tables
2.3.1-2
3.1.1-053a
3.1.1-059a
3.1.2-2

10. Further Evaluation of Aging Management Associated With Increase in Porosity and Permeability Due to Leaching of Calcium Hydroxide and Carbonation in Inaccessible Concrete Areas

Further evaluation of aging management associated with increase in porosity and permeability due to leaching of calcium hydroxide and carbonation in inaccessible concrete areas is clarified in SLRA Sections 3.5.2.2.1.9, 3.5.2.2.2.1(4), and 3.5.2.2.2.3(3). The further evaluations are clarified to indicate that there is evidence of leaching in the accessible areas exposed to a water–flowing environment. Evaluation has determined that the observed leaching in accessible areas did not adversely impact the structural integrity or resulted in a loss of intended function of the inaccessible concrete areas. This applies to Containment and concrete structures within the scope of subsequent license renewal.

Based on the above, the SLRA is supplemented as shown in Enclosure 2, to clarify the further evaluations in the following:

SLRA Section
3.5.2.2.1.9
3.5.2.2.2.1(4)
3.5.2.2.2.3(3)

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Enclosure 2

SLRA MARK-UPS
CHANGE NOTICE 3

Virginia Electric and Power Company
(Dominion Energy Virginia)
Surry Power Station Units 1 and 2

SLRA Section	SLRA As-Submitted Pages*	Enclosure 1 Topic #
Table 2.3.1-2	2-58, 2-59	9
2.4.1.27	2-289	3
2.4.1.38	2-303	2
Table 2.4.1-27	2-332	3
3.1.2.1.3	3-16	2
Table 3.1.1	3-56, 3-62	9
Table 3.1.2-2	3-90, 3-91	9
Table 3.1.2-3	3-105	2
3.5.2.1.27	3-717	3
3.5.2.2.1.9	3-738	10
3.5.2.2.2.1(4)	3-741	10
3.5.2.2.2.3(3)	3-744	10
3.5.2.2.2.5	3-746	1
Table 3.5.1	3-759, 3-760, 3-764	1, 2, 3
Table 3.5.2-27	3-835	3
Table 3.5.2-36	3-848, 3-849	1
Table 3.5.2-38	3-854	1
4.2.5	4-71	4
Appendix A		
A1.16	A-14	6
A1.32	A-27	5
A1.34	A-28, A-29	8
Table A4.0-1	A-71 to A-73, A-92	6, 8

SLRA Section	SLRA As-Submitted Pages*	Enclosure 1 Topic #
Appendix B		
B2.1.16	B-108 to B-119	6
B2.1.33	B-220 to B-222	9
B2.1.34	B-223 to B-229	8
Appendix C		
Table C3.3-3	C-29, C-31, C-36, C-37, C-41	9
Table C4.3-1	C-54, C-56, C-58	9
Table C4.3-2	C-59, C-60, C-61	9

* SLRA As-Submitted page numbers may not correspond to the page numbers in Enclosure 2.

Table 2.3.1-2 Reactor Vessel Internals

Subcomponent	Intended Function(s)
Alignment and interfacing (clevis insert bolt)	Structural Support
Alignment and interfacing (clevis insert dowel)	Structural Support
Alignment and interfacing (clevis insert wear surface)	Structural Support
Alignment and interfacing (internals hold-down spring)	Structural Support
Alignment and interfacing (radial support key wear surface)	Structural Support
Alignment and interfacing (thermal sleeve)	Structural Support
Alignment and interfacing (upper core plate alignment pin wear surface)	Structural Support
Alignment and interfacing (upper core plate alignment pin)	Structural Support
Baffle former (baffle edge bolt)	Structural Support
Baffle former (baffle former bolt)	Structural Support
Baffle former (baffle plate)	Flow Distribution, Structural Support
Baffle former (corner bolt)	Structural Support
Bottom mounted instrumentation (column body)	Structural Support
Bottom mounted instrumentation (flux thimble tube)	Structural Support
Control rod guide tube (continuous section sheath and C-tube)	Structural Support
Control rod guide tube (guide plate)	Structural Support
Control rod guide tube (guide tube support pin nut) (Unit 1 only)	Structural Support

See Table 2.1.5-1 for definitions of intended functions.

Table 2.3.1-2 Reactor Vessel Internals

Subcomponent	Intended Function(s)
Control rod guide tube (guide tube support pin) (Unit 1 only)	Structural Support
Control rod guide tube (lower flange)	Structural Support
Core barrel (barrel former bolt)	Structural Support
Core barrel (core barrel flange)	Flow Distribution, Structural Support
~~Core barrel (core barrel outlet nozzle)~~	~~Structural Support~~
Core barrel (lower axial weld)	Structural Support
Core barrel (lower flange weld)	Structural Support
Core barrel (lower girth weld)	Structural Support
Core barrel (upper axial weld)	Structural Support
Core barrel (upper flange weld)	Structural Support
Core barrel (upper girth weld)	Structural Support
Lower internals (fuel alignment pin)	Structural Support
Lower internals (lower core plate)	Flow Distribution, Structural Support
Lower support (column body)	Structural Support
Lower support (column bolt)	Structural Support
Lower support (lower support forging)	Structural Support
No additional measures components	Flow Distribution, Structural Support
Thermal shield (flexure)	Structural Support
Upper internals (fuel alignment pin)	Structural Support
Upper internals (upper core plate)	Structural Support

See Table 2.1.5-1 for definitions of intended functions.

2.4.1.27 Fire Protection and Domestic Water Tank Foundation

System Description

The Fire Protection/Domestic Water Tank Foundations are supported on well-tamped sand and gravel with an oiled-sand cushion between the tank and the backfill. To contain this material under the tanks, reinforced concrete ring walls, whose tops are approximately at grade, were constructed just outside the perimeter of the tank. The Fire Protection/Domestic Water Tank Foundations are located adjacent to the Fire Pump House, west of the Intake Canal.

System Evaluation Boundary

The evaluation boundary for the Fire Protection/Domestic Water Tank Foundations includes the reinforced concrete ring walls constructed just outside the perimeter of the tank and the oiled-sand cushion under the tank.

The Fire Protection/Domestic Water Tank is evaluated in the fire protection system.

System Intended Functions

The Fire Protection/Domestic Water Tank Foundations are relied upon for compliance with regulations for Fire Protection (10 CFR 50.48). Therefore, the Fire Protection/Domestic Water Tank Foundations are within the scope of license renewal in accordance with the criteria of 10 CFR 54.4(a)(3).

UFSAR References

Additional details of the Fire Protection and Domestic Water Tank Foundation can be found in the UFSAR, Section 9.10.2.2.1.

Subsequent License Renewal Boundary Drawings

The subsequent license renewal boundary drawing for the Fire Protection and Domestic Water Tank Foundation is listed below:

11448-SLRY-1H

Components Subject to Aging Management Review

The component types subject to aging management review are indicated in Table 2.4.1-27, Fire Protection and Domestic Water Tank Foundation.

The aging management review results for these component types are indicated in Table 3.5.2-27, Containments, Structures and Component Supports - Fire Protection and Domestic Water Tank Foundation - Aging Management Evaluation.

System Evaluation Boundary

The evaluation boundary for the NSSS Supports includes all supports for Nuclear Steam Supply System components. The evaluation boundary for each nuclear steam supply system support lies between the integral attachment on piping and equipment being supported and its ~~Containment concrete~~ supporting structure.

Specifically:

- Pins, bolting, and other removable hardware that are part of the connection to the NSSS equipment integral attachment have been evaluated with the nuclear steam supply system equipment supports.
- Spring supports, sliding surfaces, stainless steel elements, steel elements.
- Exposed portions of the embedded components (i.e. end portion of threaded anchor and nut) and grout are evaluated with the nuclear steam supply system equipment supports.
- Concrete supporting structures (including the embedded portion of threaded anchor) are evaluated with the Containment.
- Integral attachments for the nuclear steam supply system piping and equipment are evaluated for aging management with the specific nuclear steam supply system equipment.
- The neutron shield tank is evaluated with the reactor coolant system.
- Snubbers are active components and not subject to aging management.

System Intended Functions

Portions of the NSSS Supports perform the following safety-related function: The NSSS Supports provide structural support for safety-related SSCs. Therefore, the NSSS Supports are within the scope of license renewal in accordance with the criteria of 10 CFR 54.4(a)(1).

UFSAR References

Additional details of the NSSS Supports can be found in the UFSAR, Section 15.6.2, Figure 15.6-1, Figure 15.6-2, Figure 15.6-3, Figure 15.6-4, Table 15.6-1, and Table 15.6-2.

Subsequent License Renewal Boundary Drawings

There are no subsequent license renewal boundary drawing for the NSSS Supports.

Components Subject to Aging Management Review

The component types subject to aging management review are indicated in Table 2.4.1-38, NSSS Supports.

The aging management review results for these component types are indicated in Table 3.5.2-38, Containments, Structures and Component Supports - NSSS Supports - Aging Management Evaluation.

Table 2.4.1-27 Fire Protection and Domestic Water Tank Foundation

Structural Member	Intended Function(s)
Concrete element	Structural Support
Oiled-sand cushion	Structural Support

The AMR results for these component types are indicated in Table 3.5.2-27, Containments, Structures and Component Supports - Fire Protection and Domestic Water Tank Foundation - Aging Management Evaluation.

See Table 2.1.5-1 for definitions of intended functions.

Aging Effects Requiring Management

The following aging effects, associated with the reactor coolant system, require management:

- Cracking
- Cumulative fatigue damage
- Long-term loss of material
- Loss of coating or lining integrity
- Loss of fracture toughness
- Loss of material
- Loss of preload
- Reduction of heat transfer
- Reduced thermal insulation resistance

Aging Management Programs

The following aging management programs manage the aging effects for the reactor coolant system component types:

- ASME Code Class 1 Small-Bore Piping (B2.1.22)
- ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B2.1.1)
- Bolting Integrity (B2.1.9)
- Boric Acid Corrosion (B2.1.4)
- Closed Treated Water Systems (B2.1.12)
- External Surfaces Monitoring of Mechanical Components (B2.1.23)
- Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B2.1.25)
- Internal Coatings/Linings For In-Scope Piping, Piping Components, Heat Exchangers, and Tanks (B2.1.28)
- Lubricating Oil Analysis (B2.1.26)
- One-Time Inspection (B2.1.20)
- Selective Leaching (B2.1.21)
- Structures Monitoring (B2.1.34)
- Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) (B2.1.6)
- Water Chemistry (B2.1.2)

Table 3.1.1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report

Item Number	Component	Aging Effect/Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
3.1.1-053a	Stainless steel, nickel alloy Westinghouse reactor internal Primary components exposed to reactor coolant, neutron flux	Cracking due to SCC, irradiation-assisted SCC, fatigue	AMP XI.M16A, PWR Vessel Internals, and AMP XI.M2, Water Chemistry (for SCC mechanisms only)	Yes (SRP-SLR Section 3.1.2.2.9)	Consistent with NUREG-2191 with exceptions. Exceptions apply to the NUREG-2191 recommendations for Water Chemistry (B2.1.2) program implementation. The control rod guide tube (continuous section sheath and C-tube), core barrel (lower flange weld) and core barrel (upper girth weld) align to this item but are listed as Expansion components in the Appendix C Gap Analysis. See further evaluation in Section 3.1.2.2.9.
3.1.1-053b	Stainless steel Westinghouse reactor internal Expansion components exposed to reactor coolant and neutron flux	Cracking due to SCC, irradiation-assisted SCC, fatigue	AMP XI.M16A, PWR Vessel Internals, and AMP XI.M2, Water Chemistry (for SCC mechanisms only)	Yes (SRP-SLR Section 3.1.2.2.9)	Consistent with NUREG-2191 with exceptions. Exceptions apply to the NUREG-2191 recommendations for Water Chemistry (B2.1.2) program implementation. The brackets, clamps, terminal blocks and conduit straps located on the periphery align to this item, and are expected to be elevated to a Primary Inspection component, as described in the Appendix C Gap Analysis. The upper internals (upper core plate) aligns to this item, and is listed as a Primary Inspection component in the Appendix C Gap Analysis. See further evaluation in Section 3.1.2.2.9.
3.1.1-053c	Stainless steel, nickel alloy Westinghouse reactor internal Existing Programs components exposed to reactor coolant, neutron flux	Cracking due to SCC, irradiation-assisted SCC, fatigue	AMP XI.M16A, PWR Vessel Internals, and AMP XI.M2, Water Chemistry (for SCC mechanisms only)	Yes (SRP-SLR Section 3.1.2.2.9)	Consistent with NUREG-2191 with exceptions. Exceptions apply to the NUREG-2191 recommendations for Water Chemistry (B2.1.2) program implementation. Clevis insert bolts and dowels align to this item, but are listed as Primary Inspection components in the Appendix C Gap Analysis. See further evaluation in Section 3.1.2.2.9.
3.1.1-054	Stainless steel bottom mounted instrument system flux thimble tubes (with or without chrome plating) exposed to reactor coolant and neutron flux	Loss of material due to wear	AMP XI.M37, Flux Thimble Tube Inspection	No	Not applicable. Loss of material due to wear is addressed in row 3.1.1-028. The associated NUREG-2192 aging item is not used.

Table 3.1.1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report

Item Number	Component	Aging Effect/Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
3.1.1-059a	Stainless steel (SS, including CASS, PH SS or martensitic SS) or nickel alloy Westinghouse reactor internal Primary components exposed to reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement and for CASS, martensitic SS, and PH SS due to thermal aging embrittlement; changes in dimensions due to void swelling, distortion; loss of preload due to thermal and irradiation-enhanced stress relaxation, creep; loss of material due to wear	AMP XI.M16A, PWR Vessel Internals	Yes (SRP-SLR Section 3.1.2.2.9)	Consistent with NUREG-2191. The control rod guide tube (continuous section sheath and C-tube), core barrel (lower flange and lower axial welds) and the lower support (column body) also align to this item, but are listed as Expansion components in the Appendix C Gap Analysis. The lower internals (fuel alignment pin) also aligns to this item, but is listed as an Existing component in the Appendix C Gap Analysis. See further evaluation in Section 3.1.2.2.9.

Table 3.1.2-2 Reactor Vessel, Internals, and Reactor Coolant System - Reactor Vessel Internals - Aging Management Evaluation

Subcomponent	Intended Function(s)	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-2191 Item	Table 1 Item	Notes
Bottom mounted instrumentation (flux thimble tube)	SS	Nickel alloy	(E) Reactor coolant and neutron flux	Cracking	PWR Vessel Internals (B2.1.7)	IV.B2.RP-355	3.1.1-053c	C
					Water Chemistry (B2.1.2)	IV.B2.RP-355	3.1.1-053c	D
				Loss of fracture toughness; changes in dimensions; loss of preload; loss of material	PWR Vessel Internals (B2.1.7)	IV.B2.R-424	3.1.1-119	E, 3
				Loss of material	Flux Thimble Tube Inspection (B2.1.24)	IV.B2.RP-356	3.1.1-028	E, 2
Control rod guide tube (continuous section sheath and C-tube)	SS	Stainless steel	(E) Reactor coolant and neutron flux	Cracking	PWR Vessel Internals (B2.1.7)	IV.B2.RP-298	3.1.1-053a	C
					Water Chemistry (B2.1.2)	IV.B2.RP-298	3.1.1-053a	D
				Loss of material	PWR Vessel Internals (B2.1.7)	IV.B2.RP-296	3.1.1-059a	C
Control rod guide tube (guide plate)	SS	Cast austenitic stainless steel	(E) Reactor coolant >250°C (>482°F) and neutron flux	Cracking	PWR Vessel Internals (B2.1.7)	IV.B2.RP-298	3.1.1-053a	C
					Water Chemistry (B2.1.2)	IV.B2.RP-298	3.1.1-053a	D
				Loss of fracture toughness	PWR Vessel Internals (B2.1.7)	IV.B2.RP-297	3.1.1-059a	C
				Loss of material	PWR Vessel Internals (B2.1.7)	IV.B2.RP-296	3.1.1-059a	A
		Stainless steel	(E) Reactor coolant and neutron flux	Cracking	PWR Vessel Internals (B2.1.7)	IV.B2.RP-298	3.1.1-053a	C
					Water Chemistry (B2.1.2)	IV.B2.RP-298	3.1.1-053a	D
				Loss of material	PWR Vessel Internals (B2.1.7)	IV.B2.RP-296	3.1.1-059a	A
Control rod guide tube (guide tube support pin nut) (Unit 1 only)	SS	Nickel alloy	(E) Reactor coolant and neutron flux	Cracking	PWR Vessel Internals (B2.1.7)	IV.B2.RP-355	3.1.1-053c	C,10
				Loss of fracture toughness; loss of preload	PWR Vessel Internals (B2.1.7)	IV>B2.RP-287	3.1.1-059b	C,10, 11
Control rod guide tube (guide tube support pin) (Unit 1 only)	SS	Nickel alloy	(E) Reactor coolant and neutron flux	Cracking	PWR Vessel Internals (B2.1.7)	IV.B2.RP-355	3.1.1-053c	A,10
					Water Chemistry (B2.1.2)	IV.B2.RP-355	3.1.1-053c	B,10
				Loss of fracture toughness; loss of preload	PWR Vessel Internals (B2.1.7)	IV.B2.RP-287	3.1.1-059b	C,10
				Loss of material; loss of preload	PWR Vessel Internals (B2.1.7)	IV.B2.RP-285	3.1.1-059c	C,10

Table 3.1.2-2 Reactor Vessel, Internals, and Reactor Coolant System - Reactor Vessel Internals - Aging Management Evaluation

Subcomponent	Intended Function(s)	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-2191 Item	Table 1 Item	Notes
Control rod guide tube (lower flange)	SS	Cast austenitic stainless steel	(E) Reactor coolant >250°C (>482°F) and neutron flux	Cracking	PWR Vessel Internals (B2.1.7)	IV.B2.RP-298	3.1.1-053a	C, 8
					Water Chemistry (B2.1.2)	IV.B2.RP-298	3.1.1-053a	D, 8
				Loss of fracture toughness	PWR Vessel Internals (B2.1.7)	IV.B2.RP-297	3.1.1-059a	C, 8
		Stainless steel	(E) Reactor coolant and neutron flux	Cracking	PWR Vessel Internals (B2.1.7)	IV.B2.RP-298	3.1.1-053a	A
					Water Chemistry (B2.1.2)	IV.B2.RP-298	3.1.1-053a	B
				Loss of fracture toughness	PWR Vessel Internals (B2.1.7)	IV.B2.RP-297	3.1.1-059a	A
Core barrel (barrel former bolt)	SS	Stainless steel	(E) Reactor coolant and neutron flux	Cracking	PWR Vessel Internals (B2.1.7)	IV.B2.RP-273	3.1.1-053b	A
					Water Chemistry (B2.1.2)	IV.B2.RP-273	3.1.1-053b	B
				Loss of fracture toughness; changes in dimensions; loss of preload	PWR Vessel Internals (B2.1.7)	IV.B2.RP-274	3.1.1-059b	A
				Loss of material	PWR Vessel Internals (B2.1.7)	IV.B2.RP-345	3.1.1-059c	A
Core barrel (core barrel flange)	FD;SS	Stainless steel	(E) Reactor coolant and neutron flux	Cracking	PWR Vessel Internals (B2.1.7)	IV.B2.RP-280	3.1.1-053a	A
					Water Chemistry (B2.1.2)	IV.B2.RP-280	3.1.1-053a	B
				Loss of material	PWR Vessel Internals (B2.1.7)	IV.B2.RP-345	3.1.1-059c	A
~~Core barrel (core barrel outlet nozzle)~~	~~SS~~	~~Stainless steel~~	~~(E) Reactor coolant and neutron flux~~	~~Cracking~~	~~PWR Vessel Internals (B2.1.7)~~	~~IV.B2.RP-278~~	~~3.1.1-053b~~	~~A, 9~~
					~~Water Chemistry (B2.1.2)~~	~~IV.B2.RP-278~~	~~3.1.1-053b~~	~~B, 9~~
				~~Loss of material~~	~~PWR Vessel Internals (B2.1.7)~~	~~IV.B2.RP-200b~~	~~3.1.1-059b~~	~~C~~
Core barrel (lower axial weld)	SS	Stainless steel	(E) Reactor coolant and neutron flux	Changes in dimensions	PWR Vessel Internals (B2.1.7)	IV.B2.RP-270	3.1.1-059a	C
				Cracking	PWR Vessel Internals (B2.1.7)	IV.B2.RP-387a	3.1.1-053b	A
					Water Chemistry (B2.1.2)	IV.B2.RP-387a	3.1.1-053b	B
				Loss of fracture toughness	PWR Vessel Internals (B2.1.7)	IV.B2.RP-388a	3.1.1-059b	A
Core barrel (lower flange weld)	SS	Stainless steel	(E) Reactor coolant and neutron flux	Changes in dimensions	PWR Vessel Internals (B2.1.7)	IV.B2.RP-270	3.1.1-059a	C
				Cracking	PWR Vessel Internals (B2.1.7)	IV.B2.RP-280	3.1.1-053a	A
					Water Chemistry (B2.1.2)	IV.B2.RP-280	3.1.1-053a	B
				Loss of fracture toughness	PWR Vessel Internals (B2.1.7)	IV.B2.RP-297	3.1.1-059a	C

Table 3.1.2-3 Reactor Vessel, Internals, and Reactor Coolant System - Reactor Coolant - Aging Management Evaluation

Component Type	Intended Function(s)	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-2191 Item	Table 1 Item	Notes
Pressurizer (upper head and cladding)	PB	Steel with stainless steel cladding	(E) Air – indoor uncontrolled	Loss of material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	IV.C2.R-431	3.1.1-124	C
			(E) Air with borated water leakage	Loss of material	Boric Acid Corrosion (B2.1.4)	IV.C2.R-17	3.1.1-049	A
			(I) Reactor coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B2.1.1)	IV.C2.R-58	3.1.1-040	A
						IV.C2.R-25	3.1.1-042	A
					Water Chemistry (B2.1.2)	IV.C2.R-25	3.1.1-042	B
				Cumulative fatigue damage	TLAA	IV.C2.R-223	3.1.1-009	A
				Loss of material	Water Chemistry (B2.1.2)	IV.C2.RP-23	3.1.1-088	B
Pump casing (reactor coolant)	PB	Cast austenitic stainless steel	(E) Air – indoor uncontrolled	Cracking	External Surfaces Monitoring of Mechanical Components (B2.1.23)	V.A.EP-103c	3.2.1-007	A
				Loss of material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	IV.C2.R-452b	3.1.1-136	A
			(I) Reactor coolant >250°C (>482°F)	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B2.1.1)	IV.C2.R-09	3.1.1-033	A
					Water Chemistry (B2.1.2)	IV.C2.R-09	3.1.1-033	B
				Cumulative fatigue damage	TLAA	IV.C2.R-223	3.1.1-009	A
				Loss of fracture toughness	Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) (B2.1.6)	IV.C2.R-52	3.1.1-050	A
					TLAA	IV.C2.R-52	3.1.1-050	E, 1
				Loss of material	Water Chemistry (B2.1.2)	IV.C2.RP-23	3.1.1-088	B
Tank (neutron shield)	PB;SS	Steel	(E) Air – indoor uncontrolled	Loss of material	~~External Surfaces Monitoring of Mechanical Components (B2.1.23)~~	~~IV.C2.R-431~~	~~3.1.1-124~~	~~A~~
					Structures Monitoring (B2.1.34)	III.A3.TP-302	3.5.1-077	A
			(E) Air with borated water leakage	Loss of material	Boric Acid Corrosion (B2.1.4)	IV.C2.R-17	3.1.1-049	A
			(I) Closed-cycle cooling water	Loss of material	Closed Treated Water Systems (B2.1.12)	IV.C2.RP-221	3.1.1-089	B
			(E) Concrete	None	None	IV.E.RP-353	3.1.1-105	A

3.5.2.1.27 Fire Protection and Domestic Water Tank Foundation

Materials

The materials of construction for the fire protection and domestic water tank foundation structural members are:

- Concrete
- Earthfill (rip-rap, stone, soil)

Environment

The fire protection and domestic water tank foundation structural members are exposed to the following environments:

- Air – outdoor
- Groundwater
- Soil
- Water - flowing

Aging Effects Requiring Management

The following aging effects, associated with the fire protection and domestic water tank foundation structural members, require management:

- Cracking
- Cracking and distortion
- Increase in porosity and permeability
- Loss of bond
- Loss of material, loss of form
- Loss of material (spalling, scaling)
- Loss of material (spalling, scaling) and cracking
- Loss of strength

Aging Management Programs

The following aging management programs manage the aging effects for the fire protection and domestic water tank foundation structural members:

- Structures Monitoring (B2.1.34)

3.5.2.2.1.9 Increase in Porosity and Permeability Due to Leaching of Calcium Hydroxide and Carbonation

Increase in porosity and permeability due to leaching of calcium hydroxide and carbonation could occur in inaccessible areas of concrete elements of PWR and BWR concrete and steel containments. Further evaluation is recommended if leaching is observed in accessible areas that impact intended functions. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR).

[3.5.1-014] – UFSAR Section 15.3.1 discusses concrete mix designs. Reinforced concrete structures at SPS were designed, constructed, and inspected in accordance with ACI and ASTM standards, which provide for a good quality, dense, well-cured, and low permeability concrete. The mix proportions were established in accordance with ACI-301, "Specifications for Structural Concrete for Buildings." Procedural controls ensured quality throughout the batching, mixing, and placement processes. The ASME Section XI, Subsection IWL program (B2.1.30) and the Structures Monitoring program (B2.1.34) identify and manage any cracks in the containment concrete. Crack control was achieved through proper sizing, spacing, and distribution of reinforcing steel in accordance with ACI-318-63, "Building Code Requirements for Reinforced Concrete." The Structures Monitoring program (B2.1.34) and the ASME Section XI, Subsection IWL program (B2.1.30) inspect for evidence of leaching of calcium hydroxide and carbonation in accessible, and normally inaccessible structural components when scheduled maintenance work and planned plant modifications permit access. The Structures Monitoring program (B2.1.34) and the ASME Section XI, Subsection IWL program (B2.1.30) require that evaluation of inspection results includes consideration of the acceptability of inaccessible areas when conditions exist in accessible areas that could indicate the presence of, or result in, degradation to inaccessible areas. Although plant operating experience has identified evidence of leaching of calcium hydroxide and carbonation, it has been determined that the observed leaching did not adversely impact the structural integrity or result in a loss of intended function of the containment structures.~~Plant operating experience has not identified any aging effects related to increase in porosity and permeability due to leaching of calcium hydroxide and carbonation. The Structures Monitoring program (B2.1.34) and the ASME Section XI, Subsection IWL program (B2.1.30) confirm the absence of aging effects related to leaching of calcium hydroxide and carbonation.~~ Therefore, aging effects due to leaching of calcium hydroxide and carbonation are not applicable, and a plant-specific aging management program for inaccessible areas to manage the effects of increase in porosity and permeability due to leaching of calcium hydroxide and carbonation is not required.

[3.5.1-047] – Leaching - UFSAR Section 15.3.1 discusses concrete mix designs. Reinforced concrete structures at SPS were designed, constructed, and inspected in accordance with ACI and ASTM standards, which provide for a good quality, dense, well-cured, and low permeability concrete. The mix proportions were established in accordance with ACI-301, "Specifications for Structural Concrete for Buildings." Procedural controls ensured quality throughout the batching, mixing, and placement processes. The Structures Monitoring program (B2.1.34) identifies and manages any cracks in the concrete structures. Crack control was achieved through proper sizing, spacing, and distribution of reinforcing steel in accordance with ACI-318-63, "Building Code Requirements for Reinforced Concrete." Additionally, the Structures Monitoring program (B2.1.34) inspects for evidence of leaching of calcium hydroxide and carbonation in accessible, and normally inaccessible structural components when scheduled maintenance work and planned plant modifications permit access. The Structures Monitoring program (B2.1.34) requires that evaluation of inspection results includes consideration of the acceptability of inaccessible areas when conditions exist in accessible areas that could indicate the presence of, or result in, degradation to inaccessible areas. Although plant operating experience has identified evidence of leaching of calcium hydroxide and carbonation, it has been determined that the observed leaching did not adversely impact the structural integrity or result in a loss of intended function of the associated concrete structures.~~Plant operating experience has not identified any aging effects related to increase in porosity and permeability due to leaching of calcium hydroxide and carbonation.~~ Therefore, a plant-specific aging management program for inaccessible areas to manage the effects of increase in porosity and permeability due to leaching of calcium hydroxide and carbonation is not required.

3.5.2.2.2.2 Reduction of Strength and Modulus Due to Elevated Temperature

[Reduction of strength and modulus of concrete due to elevated temperatures could occur in PWR and BWR Group 1-5 concrete structures. For any concrete elements that exceed specified temperature limits, further evaluations are recommended. Appendix A of American Concrete Institute (ACI) 349-85 specifies the concrete temperature limits for normal operation or any other long-term period. The temperatures shall not exceed 66°C (150°F) except for local areas, which are allowed to have increased temperatures not to exceed 93°C (200°F). Further evaluation is recommended of a plant-specific program if any portion of the safety-related and other concrete structures exceeds specified temperature limits [i.e., general area temperature greater than 66°C (150°F) and local area temperature greater than 93°C (200°F)]. Higher temperatures may be allowed if tests and/or calculations are provided to evaluate the reduction in strength and modulus of elasticity and these reductions are applied to the design calculations. The acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR).

[3.5.1-051] – UFSAR Section 15.3.1 discusses concrete mix designs. Reinforced concrete structures at SPS were designed, constructed, and inspected in accordance with ACI and ASTM standards, which provide for a good quality, dense, well-cured, and low permeability concrete. The mix proportions were established in accordance with ACI-301, "Specifications for Structural Concrete for Buildings." Procedural controls ensured quality throughout the batching, mixing, and placement processes. The Structures Monitoring program (B2.1.34), which includes Group 6 structures, identifies and manages any cracks in the concrete structures. Crack control was achieved through proper sizing, spacing, and distribution of reinforcing steel in accordance with ACI-318-63, "Building Code Requirements for Reinforced Concrete." Additionally, the Structures Monitoring program (B2.1.34) inspects for evidence of leaching of calcium hydroxide and carbonation in accessible, and normally inaccessible structural components when scheduled maintenance work and planned plant modifications permit access. The Structures Monitoring program (B2.1.34) requires that evaluation of inspection results includes consideration of the acceptability of inaccessible areas when conditions exist in accessible areas that could indicate the presence of, or result in, degradation to inaccessible areas. Although plant operating experience has identified evidence of leaching of calcium hydroxide and carbonation, it has been determined that the observed leaching did not adversely impact the structural integrity or result in a loss of intended function of the associated concrete structures. ~~Plant operating experience has not identified any aging effects related to increase in porosity and permeability due to leaching of calcium hydroxide and carbonation.~~ Therefore, a plant-specific aging management program for inaccessible areas to manage the effects of increase in porosity and permeability due to leaching of calcium hydroxide and carbonation is not required.

3.5.2.2.2.4 Cracking Due to Stress Corrosion Cracking, and Loss of Material Due to Pitting and Crevice Corrosion

Cracking due to SSC and loss of material due to pitting and crevice corrosion could occur in: (a) Group 7 and 8 SS tank liners exposed to standing water; and (b) SS and aluminum alloy support members; welds; bolted connections; or support anchorage to building structure exposed to air or condensation (see SRP SLR Sections 3.2.2.2.2, 3.2.2.2.4, 3.2.2.2.8, and 3.2.2.2.10 for background information).

For Group 7 and 8 SS tank liners exposed to standing water, further evaluation is recommended of plant-specific programs to manage these aging effects. The acceptance criteria are described in BTP RLSB 1 (Appendix A.1 of this SRP SLR).

[3.5.1-100] – Plant-specific OE has identified pitting or crevice corrosion or cracking for stainless steel piping components exposed to air or condensation (see Further Evaluation 3.4.2.2.2). The Structures Monitoring program (B2.1.34) will manage the aging of stainless steel and aluminum alloy components to ensure that these components continue to perform their intended functions during the subsequent period of extended operation.

3.5.2.2.2.5 Cumulative Fatigue Damage Due to Fatigue

Evaluations involving time-dependent fatigue, cyclical loading, or cyclical displacement of component support members, anchor bolts, and welds for Groups B1.1, B1.2, and B1.3 component supports are TLAAs as defined in 10 CFR 54.3 only if a CLB fatigue analysis exists. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of this TLAA is addressed in Section 4.3, "Metal Fatigue Analysis," and/or Section 4.7, "Other Plant Specific Time-Limited Aging Analyses," of this SRP-SLR. For plant-specific cumulative usage factor calculations, the method used is appropriately defined and discussed in the applicable TLAAs.

[3.5.1-053] – ~~The evaluation of fatigue for component support members, anchor bolts, and welds for Group B1.1 components is addressed as a TLAA in SLRA Section 4.3.2, ASME Code, Section III, Class 1 Fatigue Analyses. The evaluation of fatigue for component support members, anchor bolts, and welds for Group B1.2 components are addressed as TLAAs in SLRA Section 4.3.3, ANSI B31.1 Allowable Stress Analyses.~~ There are no TLAAs associated with component support members, anchor bolts, and welds for Groups B1.1 and B1.2 component supports. Group B1.3 component supports are associated with BWRs; therefore, not applicable.

3.5.2.2.2.6 Reduction of Strength and Mechanical Properties of Concrete Due to Irradiation

Reduction of strength, loss of mechanical properties, and cracking due to irradiation could occur in PWR and BWR Group 4 concrete structures that are exposed to high levels of neutron and gamma radiation. These structures include the reactor (primary/biological) shield wall, the sacrificial shield wall, and the reactor vessel support/pedestal structure. Data related to the effects and significance of neutron and gamma radiation on concrete mechanical and physical properties is limited, especially for conditions (dose, temperature, etc.) representative of light water reactor (LWR) plants. However, based on literature review of existing research, radiation fluence limits of 1×10^{19} neutrons/cm^2 neutron radiation and 1×10^8 Gy (1×10^{10} rad) gamma dose are considered conservative radiation exposure levels beyond which concrete material properties may begin to degrade markedly (Ref. 17, 18, 19).

Table 3.5.1 Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the GALL-SLR Report

Item Number	Component	Aging Effect/Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
3.5.1-052	Groups 7, 8 - steel components: tank liner	Cracking due to SCC; Loss of material due to pitting and crevice corrosion	Plant-specific aging management program	Yes (SRP-SLR Section 3.5.2.2.2.4)	Not applicable. See further evaluation in Section 3.5.2.2.2.4.
3.5.1-053	Support members; welds; bolted connections; support anchorage to building structure	Cumulative fatigue damage due to cyclic loading (Only if CLB fatigue analysis exists)	TLAA, SRP-SLR Section 4.3 Metal Fatigue, and/or Section 4.7 Other Plant-Specific Time-Limited Aging Analyses	Yes (SRP-SLR Section 3.5.2.2.2.5)	~~Consistent with NUREG-2191. Cumulative fatigue damage of bolting and steel elements is a TLAA.~~Not applicable. There are no TLAAs associated with support members, anchor bolts, and welds for component supports. See further evaluation in Section 3.5.2.2.2.5.
3.5.1-054	All groups except 6: concrete (accessible areas): all	Cracking due to expansion from reaction with aggregates	AMP XI.S6, Structures Monitoring	No	Consistent with NUREG-2191.
3.5.1-055	Building concrete at locations of expansion and grouted anchors; grout pads for support base plates	Reduction in concrete anchor capacity due to local concrete degradation/ service-induced cracking or other concrete aging mechanisms	AMP XI.S6, Structures Monitoring	No	Consistent with NUREG-2191.
3.5.1-056	Concrete: exterior above- and below- grade; foundation; interior slab	Loss of material due to abrasion; cavitation	AMP XI.S7, Inspection of Water-Control Structures Associated with Nuclear Power Plants or the FERC/US Army Corp of Engineers dam inspections and maintenance programs.	No	Consistent with NUREG-2191. Loss of material of concrete elements exposed to water-flowing is managed by the Inspection of Water-Control Structures Associated with Nuclear Power Plants (B2.1.35) program.

Table 3.5.1 Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the GALL-SLR Report

Item Number	Component	Aging Effect/Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
3.5.1-057	Constant and variable load spring hangers; guides; stops	Loss of mechanical function due to corrosion, distortion, dirt or debris accumulation, overload, wear	AMP XI.S3, ASME Section XI, Subsection IWF	No	Consistent with NUREG-2191.
3.5.1-058	Earthen water-control structures: dams; embankments; reservoirs; channels; canals and ponds	Loss of material; loss of form due to erosion, settlement, sedimentation, frost action, waves, currents, surface runoff, seepage	AMP XI.S7, Inspection of Water-Control Structures Associated with Nuclear Power Plants or the FERC/US Army Corp of Engineers dam inspections and maintenance programs.	No	Consistent with NUREG-2191. Loss of material; loss of form of earthen dike and embankment is managed by the Inspection of Water-Control Structures Associated with Nuclear Power Plants (B2.1.35) program. A different aging management program (Structures Monitoring (B2.1.34)) is credited for managing loss of material and loss of form of the oiled-sand cushion supporting the Fire Protection/Domestic Water Storage tanks.
3.5.1-059	Group 6: concrete (accessible areas): all	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	AMP XI.S7, Inspection of Water-Control Structures Associated with Nuclear Power Plants or the FERC/US Army Corp of Engineers dam inspections and maintenance programs.	No	Consistent with NUREG-2191. Cracking; loss of bond; and loss of material (spalling, scaling) of group 6 concrete elements (accessible areas) is managed by the Inspection of Water-Control Structures Associated with Nuclear Power Plants (B2.1.35) program.
3.5.1-060	Group 6: concrete (accessible areas): exterior above- and below-grade; foundation	Loss of material (spalling, scaling) and cracking due to freeze-thaw	AMP XI.S7, Inspection of Water-Control Structures Associated with Nuclear Power Plants or the FERC/US Army Corp of Engineers dam inspections and maintenance programs.	No	Consistent with NUREG-2191. Loss of material (spalling, scaling) and cracking due to freeze-thaw of group 6 concrete elements (accessible areas) is managed by the Inspection of Water-Control Structures Associated with Nuclear Power Plants (B2.1.35) program.

Table 3.5.1 Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the GALL-SLR Report

Item Number	Component	Aging Effect/Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
3.5.1-076	Sliding surfaces: radial beam seats in BWR drywell	Loss of mechanical function due to corrosion, distortion, dirt or debris accumulation, overload, wear	AMP XI.S6, Structures Monitoring	No	Not applicable - BWR only.
3.5.1-077	Steel components: all structural steel	Loss of material due to corrosion	AMP XI.S6, Structures Monitoring	No	Consistent with NUREG-2191. For those components credited with a fire barrier function, the Fire Protection Program (B2.1.15) is used in conjunction with the Structures Monitoring Program (B2.1.34) to manage loss of material. In addition to Containments, Structures, and Component Supports; the neutron shield tank, which is evaluated with the reactor coolant system, is aligned to this item.
3.5.1-078	Stainless steel fuel pool liner	Cracking due to SCC; Loss of material due to pitting and crevice corrosion	AMP XI.M2, Water Chemistry, and monitoring of the spent fuel pool water level and leakage from the leak chase channels.	No	Consistent with NUREG-2191 with exceptions. Exceptions apply to the NUREG-2191 recommendations for Water Chemistry (B2.1.2) program implementation. Monitoring of the spent fuel pool water level and leakage from the leak chase channels is performed by the Structures Monitoring (B2.1.34) program.
3.5.1-079	Steel components: piles	Loss of material due to corrosion	AMP XI.S6, Structures Monitoring	No	Consistent with NUREG-2191.
3.5.1-080	Structural bolting	Loss of material due to general, pitting, crevice corrosion	AMP XI.S6, Structures Monitoring	No	Consistent with NUREG-2191.
3.5.1-081	Structural bolting	Loss of material due to general, pitting, crevice corrosion	AMP XI.S3, ASME Section XI, Subsection IWF	No	Consistent with NUREG-2191.
3.5.1-082	Structural bolting	Loss of material due to general, pitting, crevice corrosion	AMP XI.S6, Structures Monitoring	No	Consistent with NUREG-2191.

Table 3.5.2-27 Containments, Structures and Component Supports - Fire Protection and Domestic Water Tank Foundation - Aging Management Evaluation

Structural Member	Intended Function(s)	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-2191 Item	Table 1 Item	Notes
Concrete element	SS	Concrete	(E) Air – outdoor	Cracking	Structures Monitoring (B2.1.34)	III.A3.TP-204	3.5.1-043	E, 1, 2
						III.A3.TP-25	3.5.1-054	A, 2
				Cracking; loss of bond; and loss of material (spalling, scaling)	Structures Monitoring (B2.1.34)	III.A3.TP-26	3.5.1-066	A, 2
				Loss of material (spalling, scaling) and cracking	Structures Monitoring (B2.1.34)	III.A3.TP-23	3.5.1-064	A, 2
			(E) Groundwater	Cracking; loss of bond; and loss of material (spalling, scaling)	Structures Monitoring (B2.1.34)	III.A3.TP-212	3.5.1-065	A, 2
						III.A3.TP-27	3.5.1-065	A, 2
				Increase in porosity and permeability; cracking; loss of material (spalling, scaling)	Structures Monitoring (B2.1.34)	III.A3.TP-29	3.5.1-067	A, 2
			(E) Soil	Cracking	Structures Monitoring (B2.1.34)	III.A3.TP-204	3.5.1-043	E, 1, 2
				Cracking and distortion	Structures Monitoring (B2.1.34)	III.A3.TP-30	3.5.1-044	A, 2
				Cracking; loss of bond; and loss of material (spalling, scaling)	Structures Monitoring (B2.1.34)	III.A3.TP-212	3.5.1-065	A, 2
						III.A3.TP-27	3.5.1-065	A, 2
				Increase in porosity and permeability; cracking; loss of material (spalling, scaling)	Structures Monitoring (B2.1.34)	III.A3.TP-29	3.5.1-067	A, 2
			(E) Water - flowing	Increase in porosity and permeability; loss of strength	Structures Monitoring (B2.1.34)	III.A3.TP-24	33.5.1-067	A, 2
Oiled-sand cushion	SS	Earthfill (rip-rap, stone, soil)	(E) Air – outdoor	Loss of material; loss of form	Structures Monitoring (B2.1.34)	III.A6.T-22	3.5.1-058	E, 3

Table 3.5.2-27 Plant-Specific Notes:

1. The plant-specific aging management program used to manage the applicable aging effect(s) for this component type, material, and environment combination is the Structures Monitoring (B2.1.34) program.

2. Concrete element includes the ring wall.

3. Structures Monitoring (B2.1.34) program instead of Inspection of Water-Control Structures Associates with Nuclear Power Plants (B2..35 program will manage loss of materials; loss of form of the oiled-sand cushion supporting the Fire-Protection/Domestic Water Storage tanks.

Table 3.5.2-36 Containments, Structures and Component Supports - Component Supports - Aging Management Evaluation

Structural Member	Intended Function(s)	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-2191 Item	Table 1 Item	Notes
Aluminum elements	EN;SS	Aluminum	(E) Air	Loss of material; cracking	Structures Monitoring (B2.1.34)	III.B2.T-37b	3.5.1-100	A, 2
						III.B3.T-37b	3.5.1-100	A, 2
						III.B4.T-37b	3.5.1-100	A, 2
						III.B5.T-37b	3.5.1-100	A, 2
Bolting	SS	Steel	(E) Air – indoor uncontrolled	~~Cumulative fatigue damage (Only if CLB fatigue analysis exists)~~	~~TLAA~~	~~III.B1.2.T-26~~	~~3.5.1-053~~	~~A~~
				Loss of material	Structures Monitoring (B2.1.34)	III.B2.TP-248	3.5.1-080	A
						III.B3.TP-248	3.5.1-080	A
						III.B4.TP-248	3.5.1-080	A
						III.B5.TP-248	3.5.1-080	A
					ASME Section XI, Subsection IWF (B2.1.31)	III.B1.2.TP-226	3.5.1-081	A
						III.B1.2.T-24	3.5.1-091	A
					Structures Monitoring (B2.1.34)	III.B2.TP-43	3.5.1-092	A
						III.B3.TP-43	3.5.1-092	A
						III.B4.TP-43	3.5.1-092	A
						III.B5.TP-43	3.5.1-092	A
				Loss of preload	ASME Section XI, Subsection IWF (B2.1.31)	III.B1.2.TP-229	3.5.1-087	A
					Structures Monitoring (B2.1.34)	III.B2.TP-261	3.5.1-088	A
						III.B3.TP-261	3.5.1-088	A
						III.B4.TP-261	3.5.1-088	A
						III.B5.TP-261	3.5.1-088	A
			(E) Air with borated water leakage	Loss of material	Boric Acid Corrosion (B2.1.4)	III.B1.2.T-25	3.5.1-089	A
						III.B2.T-25	3.5.1-089	A
						III.B3.T-25	3.5.1-089	A
						III.B4.T-25	3.5.1-089	A
						III.B5.T-25	3.5.1-089	A
						III.B5.T-25	3.5.1-089	A

Table 3.5.2-36 Containments, Structures and Component Supports - Component Supports - Aging Management Evaluation

Structural Member	Intended Function(s)	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-2191 Item	Table 1 Item	Notes
Grout	SS	Grout	(E) Air – indoor uncontrolled	Reduction in concrete anchor capacity	Structures Monitoring (B2.1.34)	III.B1.2.TP-42	3.5.1-055	A
						III.B2.TP-42	3.5.1-055	A
						III.B3.TP-42	3.5.1-055	A
						III.B4.TP-42	3.5.1-055	A
						III.B5.TP-42	3.5.1-055	A
Sliding surfaces	SS	Lubrite	(E) Air – indoor uncontrolled	Loss of mechanical function	Structures Monitoring (B2.1.34)	III.B2.TP-46	3.5.1-074	A
Spring support	SS	Steel	(E) Air – indoor uncontrolled	Loss of mechanical function	ASME Section XI, Subsection IWF (B2.1.31)	III.B1.2.T-28	3.5.1-057	A
			(E) Air with borated water leakage	Loss of material	Boric Acid Corrosion (B2.1.4)	III.B2.T-25	3.5.1-089	A
Stainless steel elements	SS	Stainless steel	(E) Air	Loss of material; cracking	ASME Section XI, Subsection IWF (B2.1.31)	III.B1.2.T-36b	3.5.1-099	A
Steel elements	EN;SS	Steel	(E) Air – indoor uncontrolled	~~Cumulative fatigue damage (Only if CLB fatigue analysis exists)~~	~~TLAA~~	~~III.B1.2.T-26~~	~~3.5.1-053~~	~~A, 1~~
				Loss of material	ASME Section XI, Subsection IWF (B2.1.31)	III.B1.2.T-24	3.5.1-091	A, 1
					Structures Monitoring (B2.1.34)	III.B2.TP-43	3.5.1-092	A, 1
						III.B3.TP-43	3.5.1-092	A, 1
						III.B4.TP-43	3.5.1-092	A, 1
						III.B5.TP-43	3.5.1-092	A, 1
			(E) Air with borated water leakage	Loss of material	Boric Acid Corrosion (B2.1.4)	III.B1.2.T-25	3.5.1-089	A, 1
						III.B2.T-25	3.5.1-089	A, 1
						III.B3.T-25	3.5.1-089	A, 1
						III.B4.T-25	3.5.1-089	A, 1
						III.B5.T-25	3.5.1-089	A, 1
Vibration isolation elements	SS	Non-metallic (e.g., rubber)	(E) Air – indoor uncontrolled	Reduction or loss of isolation function	Structures Monitoring (B2.1.34)	III.B4.TP-44	3.5.1-094	A

Table 3.5.2-38 Containments, Structures and Component Supports - NSSS Supports - Aging Management Evaluation

Structural Member	Intended Function(s)	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-2191 Item	Table 1 Item	Notes
Bolting	SS	High-strength steel	(E) Air	Cracking	ASME Section XI, Subsection IWF (B2.1.31)	III.B1.1.TP-41	3.5.1-068	A
		Stainless steel	(E) Air	Loss of material; cracking	ASME Section XI, Subsection IWF (B2.1.31)	III.B1.1.T-36b	3.5.1-099	A
			(E) Air with borated water leakage	None	None	III.B1.1.TP-4	3.5.1-098	A
		Steel	(E) Air – indoor uncontrolled	Loss of material	ASME Section XI, Subsection IWF (B2.1.31)	III.B1.1.TP-226	3.5.1-081	A
				Loss of preload	ASME Section XI, Subsection IWF (B2.1.31)	III.B1.1.TP-229	3.5.1-087	A
			(E) Air with borated water leakage	Loss of material	Boric Acid Corrosion (B2.1.4)	III.B1.1.T-25	3.5.1-089	A
Grout	SS	Grout	(E) Air – indoor uncontrolled	Reduction in concrete anchor capacity	Structures Monitoring (B2.1.34)	III.B1.1.TP-42	3.5.1-055	A
Sliding surfaces	SS	Lubrite	(E) Air – indoor uncontrolled	Loss of mechanical function	ASME Section XI, Subsection IWF (B2.1.31)	III.B1.1.TP-45	3.5.1-075	A
Stainless steel elements	SS	Stainless steel	(E) Air	Loss of material; cracking	ASME Section XI, Subsection IWF (B2.1.31)	III.B1.1.T-36b	3.5.1-099	A, 2
			(E) Air with borated water leakage	None	None	III.B1.1.TP-4	3.5.1-098	A, 2
Steel elements	SS	Steel	(E) Air – indoor uncontrolled	~~Cumulative fatigue damage (Only if CLB fatigue analysis exists)~~	~~TLAA~~	~~III.B1.1.T-26~~	~~3.5.1-053~~	~~A, 1~~
				Loss of material	ASME Section XI, Subsection IWF (B2.1.31)	III.B1.1.T-24	3.5.1-091	A, 1
				Loss of mechanical function	ASME Section XI, Subsection IWF (B2.1.31)	III.B1.1.T-28	3.5.1-057	A, 1
			(E) Air with borated water leakage	Loss of material	Boric Acid Corrosion (B2.1.4)	III.B1.1.T-25	3.5.1-089	A, 1

Table 3.5.2-38 Plant-Specific Notes:

1. Steel elements include support members, spring supports, bearing plates, base plates, and connections, including maraging steel.
2. Stainless steel elements include support members.

4.2.5 PRESSURE-TEMPERATURE LIMITS

TLAA Description:

10 CFR 50 Appendix G requires that the RV be maintained within established pressure-temperature (P-T) limits, including heatup and cooldown operations. These limits specify the maximum allowable pressure as a function of reactor coolant temperature. As the RV is exposed to increased neutron irradiation, its fracture toughness is reduced. The P-T limits must account for the anticipated RV fluence.

The current P-T limits are based upon fluence projections for 60 years of plant operation. Because they were based upon a fluence assumption of 60 years of operation, the P-T limits analyses meet the definition of 10 CFR 54.3(a) (Reference 1.7-2) and have been identified as TLAAs.

TLAA Evaluation:

Heatup and cooldown limit curves are calculated using the most limiting value of RT_{NDT} corresponding to the limiting material in the beltline region of the RV. The most limiting RT_{NDT} of the material in the core region (beltline) of the RV is determined by using the unirradiated RV material fracture toughness properties and estimating the irradiation induced shift (ΔRT_{NDT}).

RT_{NDT} increases as the material is exposed to fast neutron irradiation; therefore, to find the most limiting core region (beltline) RT_{NDT} at any time, ΔRT_{NDT} due to the neutron radiation exposure associated with that time must be added to the original unirradiated RT_{NDT}. Using the ART values, P-T limit curves are determined in accordance with the requirements of 10 CFR Part 50, Appendix G, as augmented by ASME Code, Section XI, Appendix G.

The P-T limits for 48 EFPY (currently maintained in the Technical Specifications for Units 1 and 2) are based on the K_{Ia} methodology and the latest fluence data.

According to NUREG-2192, Section 4.2.2.1.4, the P-T limits for the subsequent period of extended operation need not be submitted as part of the SLRA since the P-T limits are required to be updated through the 10 CFR 50.90 licensing process when necessary for P-T limits that are located in the Technical Specifications. The current licensing basis will ensure that the P-T limits for the subsequent period of extended operation will be updated prior to exceeding the EFPY for which they remain valid.

Nozzle materials were evaluated in WCAP-18242-NP at 48 EFPY and 68 EFPY; the nozzle forging materials evaluated are documented in Tables 4.2.4-1, 4.2.4-3, ~~4.2.2-5~~4.2.4-5, and ~~e~~4.2.4-7. All nozzle materials were assigned the fluence values at the postulated 1/4T flaw location for each specific nozzle in Table 4.2.1-1 and Table 4.2.1-2. Thus, Unit 1 Inlet Nozzle 1 and Unit 2 Inlet Nozzle 1 and Outlet Nozzle 3 have neutron fluence values greater than 1.0×10^{17} n/cm^2 (E > 1.0 MeV) at 68 EFPY. In order to fully assess the Units 1 and 2 P-T limit curves applicability to 68 EFPY, a nozzle corner fracture mechanics analysis was completed for all nozzle materials.

monitoring of air moisture content and contaminants such that specified limits are maintained, and performance of opportunistic inspections of components for indications of loss of material.

This program is based on the Surry response to NRC GL 88-14, "Instrument Air Supply Problems;" and utilizes guidance and standards provided in EPRI TR 108147 "Compressor and Instrument Air System Maintenance Guide: Revision to NP-7079," and ANSI/ISA-S7.3-1975, "Quality Standard for Instrument Air." The *Compressed Air Monitoring* program activities implement the moisture content and contaminant criteria of ANSI/ISA-S7.3-1975 (incorporated into ISA-S7.0.01-1996).

Program activities include air quality checks at various locations to ensure that dew point, particulates, and hydrocarbons are maintained within the specified limits. Opportunistic inspections of the internal surfaces of select compressed air system components for signs of loss of material will be performed.

A1.15 FIRE PROTECTION

The *Fire Protection* program is an existing condition and performance monitoring program comprised of functional tests and visual inspections. The program manages:

- loss of material for fire-rated doors, fire damper housings, the halon systems, RCP oil collection system, steel seismic gap covers and the low-pressure carbon dioxide systems
- loss of material (spalling) or cracking for concrete structures, including fire barrier walls, ceilings, and floors
- hardening, shrinkage, and loss of strength for elastomer fire barrier penetration seals and seismic gap elastomers
- loss of material, change in material properties, cracking/delamination, and separation for non-elastomer fire barrier penetration seals, fire stops, fire wraps, and coatings cracking/delamination, and separation
- loss of material and cracking for aluminum seismic gap covers

This program includes fire barrier inspections. The fire barrier inspection program requires periodic visual inspection of fire barrier penetration seals, fire barrier walls, ceilings, and floors, fire damper housings, and periodic visual inspection and functional tests of fire-rated doors to demonstrate that their operability is maintained. The program also includes periodic inspections and functional tests of the halon systems and low-pressure carbon dioxide systems.

A1.16 FIRE WATER SYSTEM

The *Fire Water System* program is an existing condition monitoring program that manages cracking, loss of material, flow blockage due to fouling, and loss of coating integrity for in-scope water-based fire protection systems. This program manages aging effects by conducting periodic

visual inspections, flow testing, and flushes consistent with provisions of the 2011 Edition of National Fire Protection Association (NFPA) 25. Testing of sprinklers that have been in place for 50 years is performed consistent with NFPA 25, 2011 Edition. With exception of two locations, portions of the water-based fire protection system that have been wetted but are normally dry have been confirmed to drain and are not subjected to augmented testing and inspections.

The water-based fire protection system is normally maintained at required operating pressure and is monitored such that loss of system pressure is detected and corrective actions initiated. Piping wall thickness measurements are conducted when visual inspections detect surface irregularities indicative of unexpected levels of degradation. When the presence of organic or inorganic material sufficient to obstruct piping or sprinklers is detected, the material is removed and the source is detected and corrected. Non-code inspections and tests follow site procedures that include inspection parameters for items such as lighting, distance offset, presence of protective coatings, and cleaning processes that ensure an adequate examination.

The training and qualification of individuals involved in coating/lining inspections of non-cementitious coatings/linings are conducted in accordance with ASTM International Standards endorsed in RG 1.54 including guidance from the staff associated with a particular standard.

A1.17 OUTDOOR AND LARGE ATMOSPHERIC METALLIC STORAGE TANKS

The *Outdoor and Large Atmospheric Metallic Storage Tanks* program is an existing condition monitoring program that manages the effects of loss of material and cracking on the outside and inside surfaces of aboveground metallic tanks constructed on concrete or soil. This program is a condition monitoring program that manages aging effects associated with outdoor tanks with internal pressures approximating atmospheric pressure including the refueling water storage tanks (RWSTs), refueling water chemical addition tanks (CATs), emergency condensate storage tanks (ECSTs), and the emergency condensate makeup tanks (ECMTs). This program also manages aging of the fire protection/domestic water storage tanks (FWSTs) bottom surfaces exposed to soil. The program includes preventive measures to mitigate corrosion by protecting the external surfaces of steel components per standard industry practice. The RWSTs are insulated and rest on a concrete foundation covered with an oil sand cushion. Caulking is used at the concrete-component interface of the RWSTs. The ECSTs and ECMTs are internally coated and protected by concrete missile barriers. Weep holes, located around the circumference of the ECSTs where the concrete missile shield meets the concrete foundation, allow drainage of leakage or condensation to the outside perimeter of the ECSTs. The weep holes will be inspected for water leakage once each refueling cycle. The CATs are skirt supported and insulated with sprayed-on rigid polyurethane foam.

The program manages loss of material on tank internal bare metal surfaces by conducting visual inspections. Surface exams of external tank surfaces are conducted to detect cracking on the

A1.31 ASME SECTION XI, SUBSECTION IWF

The *ASME Section XI, Subsection IWF* program is an existing condition monitoring program that manages loss of material, cracking, loss of preload, and loss of mechanical function for supports of Class 1, 2, and 3 components. There are no Class MC supports at SPS. This program consists of periodic visual examination of piping and component supports for signs of degradation, evaluation, and corrective actions. This program recommends additional inspections beyond the inspections required by the 10 CFR Part 50.55a *ASME Section XI, Subsection IWF* program. This includes a one-time inspection within five years prior to entering the subsequent period of extended operation of an additional 5% of the sample populations for Class 1, 2, and 3 piping supports. The additional supports will be selected from the remaining population of IWF piping supports and will include components that are most susceptible to age-related degradation. For high-strength bolting with an actual yield strength equal to or greater than 150 ksi in sizes greater than one inch nominal diameter, volumetric examination comparable to that of ASME Code, Section XI, Table IWB-2500-1, Examination Category B-G-1 are performed to detect cracking in addition to the VT-3 examination. If a component support does not exceed the acceptance standards of IWF-3400, but is electively repaired to as-new condition, the sample is increased or modified to include another support that is representative of the remaining population of supports that were not repaired.

A1.32 10 CFR PART 50, APPENDIX J

The *10 CFR Part 50, Appendix J* program is an existing performance monitoring program that manages cracking, loss of leak tightness, loss of material, loss of preload and loss of sealing. Leakage rates through the Containment pressure boundary are monitored, including the Containment liner, associated welds, penetrations, isolation valves, fittings, and other access openings to detect degradation of the Containment pressure boundary. Corrective actions are taken if leakage rates exceed acceptance criteria. Leakage rate testing is performed in accordance with the regulations and guidance provided in 10 CFR Part 50 Appendix J, Option B; Regulatory Guide 1.163, "Performance-Based Containment Leak-Test Program;" ~~and~~ NEI 94-01, "Industry Guideline for Implementing Performance-Based Option of 10 CFR 50, Appendix J;" and subject to the requirements of 10 CFR Part 54.

A1.33 MASONRY WALLS

The *Masonry Walls* program is an existing condition monitoring program that is implemented as part of the *Structures Monitoring* program (A1.34) and manages loss of material, cracking, and loss of material (spalling and scaling) that could impact the intended function of the masonry walls.

The *Masonry Walls* program consists of inspections, consistent with Inspection and Enforcement Bulletin (IEB) 80-11 and plant-specific monitoring proposed by Information Notice (IN) 87-67, for managing shrinkage, separation, gaps, loss of material and cracking of masonry walls such that the evaluation basis is not invalidated and intended functions are maintained. The inspections of the masonry walls within the scope of subsequent license renewal are conducted by qualified personnel at a frequency not to exceed five years.

A1.34 STRUCTURES MONITORING

The *Structures Monitoring* program is an existing condition monitoring program that monitors the condition of structures and structural supports that are within the scope of subsequent license renewal to manage the following aging effects:

- Cracking
- Cracking and distortion
- Cracking, loss of material
- Cracking, loss of bond, and loss of material (spalling, scaling)
- Increase in porosity and permeability, cracking, loss of material (spalling, scaling)
- Loss of material
- Loss of material, loss of form
- Loss of material, change in material properties
- Loss of material (spalling, scaling) and cracking
- Loss of mechanical function
- Loss of preload
- Loss of sealing
- Reduction in concrete anchor capacity
- Reduction of foundation strength and cracking
- Reduction or loss of isolation function

This program consists of periodic visual inspection and monitoring the condition of concrete and steel structures, structural components, component supports, and structural commodities to ensure that aging degradation (such as those described in ACI 349.3R, ACI 201.1R, and other documents)

will be detected, the extent of degradation determined and evaluated, and corrective actions taken prior to loss of intended functions. Inspections also include seismic joint fillers, elastomeric materials; and steel edge supports and steel bracings associated with masonry walls, and periodic evaluation of groundwater chemistry and opportunistic inspections for the condition of below grade concrete. Quantitative results (measurements) and qualitative information from periodic inspections are trended with photographs and surveys for the type, severity, extent, and progression of degradation. The acceptance criteria are derived from applicable consensus codes and standards. For concrete structures, the program includes personnel qualifications and quantitative acceptance criteria of ACI 349.3R-02, "Evaluation of Existing Nuclear Safety-Related Concrete Structures." The inspection of structural components, including masonry walls and water-control structures, are performed at intervals not to exceed five years, except for wooden poles, which are inspected on a 10-year frequency.

Qualified inspectors identify changes that could be indicative of Alkali-Silica Reaction (ASR). If indications of ASR development are identified, the evaluation considers the potential for ASR development in concrete that is within the scope of the *Structures Monitoring* program (A1.34), the *ASME Section XI, Subsection IWL* program (A1.30), or the *Inspection of Water-Control Structures Associated With Nuclear Power Plants* program (A1.35).

ASME Code, Section XI, visual examinations (VT-1) are conducted to detect cracking of stainless steel and aluminum components.

Table A4.0-1 Subsequent License Renewal Commitments

#	Program	Commitment	AMP	Implementation
16	*Fire Water System* program	The *Fire Water System* program is an existing condition monitoring program that will be enhanced as follows: 1. ~~Procedures inspection guidance will be revised to require replacement of any sprinkler that shows any of the following: leakage, corrosion, physical damage, loading, painting unless painted by the sprinkler manufacturer, or incorrect orientation. Sprinklers at the following locations will be added to the test scope: The Radwaste Facility, Auxiliary Boiler, Maintenance Building, Condensate Polishing Building, Laundry Building, and Machine Shop Building.~~ (Completed Change Notice 1) 2. Prior to 50 years in service, sprinkler heads will be submitted for field-service testing by a recognized testing laboratory consistent with NFPA 25, 2011 Edition, Section 5.3.1. Additional representative samples will be field-service tested every 10 years thereafter to ensure signs of aging are detected in a timely manner. For wet pipe sprinkler systems, a one-time test of sprinklers that have been exposed to water including the sample size, sample selection criteria, and minimum time in service of tested sprinklers will be performed. At each unit, a sample of 3% or a maximum of ten sprinklers with no more than four sprinklers per structure shall be tested. Testing is based on a minimum time in service of fifty years and severity of operating conditions for each population. (Revised Change Notice 2) 3. Procedures will be revised to specify: a. Standpipe and system flow tests for hose stations at the hydraulically most limiting locations for each zone of the system on a five year interval to demonstrate the capability to provide the design pressure at required flow. b. Acceptance criteria for wet pipe main drain tests. Flowing pressures from test to test will be monitored to determine if there is a 10% reduction in full flow pressure when compared to previously performed tests. The Corrective Action Program will determine the cause and necessary corrective action. c. If a flow test or a main drain test does not meet acceptance criteria due to current or projected degradation additional tests are conducted. The number of increased tests is determined in accordance with the corrective action process; however, there are no fewer than two additional tests for each test that did not meet acceptance criteria. The additional inspections are completed within the interval in which the original test was conducted. If subsequent tests do not meet acceptance criteria, an extent of condition and extent of cause analysis is conducted to determine the further extent of tests. The additional tests include at least one test at the other unit with the same material, environment, and aging effect combination. d. Main drains for the standpipes associated with hose stations within the scope of subsequent license renewal will also be added to main drain testing procedures.	B2.1.16	Program will be implemented and inspections or tests begin 5 years before the subsequent period of extended operation. Inspections or tests that are to be completed prior to the subsequent period of extended operation are completed 6 months prior to the subsequent period of extended operation or no later than the last refueling outage prior to the subsequent period of extended operation.

Table A4.0-1 Subsequent License Renewal Commitments

#	Program	Commitment	AMP	Implementation
16	*Fire Water System* program	4. Procedures will be revised to perform internal visual inspections of sprinkler and deluge system piping to identify internal corrosion, foreign material, and obstructions to flow. Follow-up volumetric examinations will be performed if internal visual inspections detect age-related degradation in excess of what would be expected accounting for design, previous inspection experience, and inspection interval. If organic or foreign material, or internal flow blockage that could result in failure of system function is identified, then an obstruction investigation will be performed within the Corrective Action Program that includes removal of the material, an extent of condition determination, review for increased inspections, extent of follow-up examinations, and a flush in accordance with NFPA 25, 2011 Edition, Annex D.5, Flushing Procedures. The internal visual inspections will consist of the following: (Relocated from Commitment 10 and corrected - Change Notice 2) a. Wet pipe sprinkler systems - 50% of the wet pipe sprinkler systems in scope for subsequent license renewal will have visual internal inspections of piping by removing a hydraulically remote sprinkler, performed every five years, consistent with NFPA 25, 2011 Edition, Section 14.2. During the next five-year inspection period, the alternate systems previously not inspected shall be inspected. b. Pre-action sprinkler systems - pre-action sprinkler systems in scope for subsequent license renewal will have visual internal inspections of piping by removing a hydraulically remote nozzle, performed every five years, consistent with NFPA 25, 2011 Edition, Section 14.2. c. Deluge systems - deluge systems in scope for subsequent license renewal will have visual internal inspections of piping by removing a hydraulically remote nozzle, performed every five years, consistent with NFPA 25, 2011 Edition, Section 14.2. 5. Procedures will be revised to perform system flow testing at flows representative of those expected during a fire. A flow resistance factor (C-factor) will be calculated to compare and trend the friction loss characteristics to the results from previous flow tests. (Renumbered Change Notice 2) 6. ~~Procedures for hydrant flushing will be revised to require fully opening the hydrant and fully flowing the hydrant for no less than one minute and until foreign material has cleared. In addition, procedures will be revised to observe draining of the hydrant barrel and also require the barrel be pumped dry should it not drain within 60 minutes. Hydrants outside the protected area that are within the scope of subsequent license renewal will be added to the flush scope.~~(Completed Change Notice 1 and renumbered Change Notice 2)) 7. ~~The Fire Water System program will be revised to periodically inspect the insulated exterior surfaces of the fire water tanks on a 10 year frequency during the subsequent period of operation. Insulation is removed to provide a minimum inspection population of 25 one square foot samples. The samples will be distributed in such a way that inspections occur on the tank dome, near the tank bottom, at points where structural supports, pipe, or instrument nozzles penetrate the insulation and where water could collect. In addition, inspection locations will be based on the likelihood of corrosion under insulation occurring.~~ Prior to the subsequent period of extended operation, the insulation on the exterior surfaces of the fire water storage tanks (FWSTs) will be permanently removed. Wall thickness measurements will be performed on external tank areas exhibiting unexpected degradation. Refurbishment/recoating will be performed consistent with the severity of the degradation identified and commensurate with the potential for loss of intended function. Inspections of external tank surfaces will be on a refueling cycle frequency. (Renumbered Change Notice 2 and revised Change Notice 3)	B2.1.16	Program will be implemented and inspections or tests begin 5 years before the subsequent period of extended operation. Inspections or tests that are to be completed prior to the subsequent period of extended operation are completed 6 months prior to the subsequent period of extended operation or no later than the last refueling outage prior to the subsequent period of extended operation.

Table A4.0-1 Subsequent License Renewal Commitments

#	Program	Commitment	AMP	Implementation
16	*Fire Water System* program	8. ~~Procedures for mainline strainer flushing will be revised to require flushing until clear water is observed after each operation or flow test. In addition to flushing after operation, the Radwaste Facility mainline strainer will require an inspection every five years for damaged and corroded parts.~~(Completed - Change Notice 1 and renumbered Change Notice 2)) 9. A procedure will be created to provide a Turbine Building oil deluge systems spray nozzle air flow test to ensure that patterns are not impeded by plugged nozzles, to ensure that nozzles are correctly positioned, and to ensure that obstructions do not prevent discharge patterns from wetting surfaces to be protected. (Renumbered Change Notice 2) ~~10. Procedures will be revised to perform internal visual inspections of sprinkler and deluge system piping to identify internal corrosion, foreign material, and obstructions to flow. Follow-up volumetric examinations will be performed if internal visual inspections detect age-related degradation in excess of what would be expected accounting for design, previous inspection experience, and inspection interval. If organic or foreign material, or internal flow blockage that could result in failure of system function is identified, then an obstruction investigation will be performed within the Corrective Action Program that includes removal of the material, an extent of condition determination, review for increased inspections, extent of follow-up examinations, and a flush in accordance with NFPA 25, 2011 Edition, Annex D.5, Flushing Procedures. The internal visual inspections will consist of the following:~~(Old Enhancement 9 was relocated to Enhancement 4 Change Notice 2) a. ~~Wet pipe sprinkler systems - 50% of the wet pipe sprinkler systems in scope for subsequent license renewal will have visual internal inspections of piping by removing a hydraulically remote sprinkler, performed every five years, consistent with NFPA 25, 2011 Edition, Section 14.2. During the next five-year inspection period, the alternate systems previously not inspected shall be inspected.~~ b. ~~Pre-action sprinkler systems - pre-action sprinkler systems in scope for subsequent license renewal will have visual internal inspections of piping by removing a hydraulically remote nozzle, performed every five years, consistent with NFPA 25, 2011 Edition, Section 14.2.~~ c. ~~Deluge systems - deluge systems in scope for subsequent license renewal will have visual internal inspections of piping by removing a hydraulically remote nozzle, performed every five years, consistent with NFPA 25, 2011 Edition, Section 14.2.~~ 10. Procedure will be revised to provide inspection guidance related to lighting, distance and offset for non-ASME Code inspections. The procedure will specify adequate lighting be verified at the inspection location to detect degradation. Lighting may be permanently installed, temporary, or portable (e.g., flashlight), as appropriate. For accessible surface inspections, inspecting from a distance of two to four feet (or less) will be appropriate. For distant surface inspections, viewing aids such as binoculars may be used. For viewing angles which may prevent adequate inspection, a viewing aid such as an inspection mirror or boroscope should be used. 11. The Unit 1 hydrogen seal oil system deluge sprinkler pipe and Unit 1 station main transformer '1A' deluge sprinkler piping will be reconfigured to allow drainage. As part of the drainage reconfiguration, visual inspections and wall thickness measurements will be performed on the Unit 1 hydrogen seal oil system deluge sprinkler pipe that does not drain. In addition, wall thickness examination of the Unit 1 main transformer deluge sprinkler piping that does not allow drainage will also be performed as part of the drainage reconfiguration. Piping with unexpected degradation will be replaced. (Revised Change Notice 3)	B2.1.16	Program will be implemented and inspections or tests begin 5 years before the subsequent period of extended operation. Inspections or tests that are to be completed prior to the subsequent period of extended operation are completed 6 months prior to the subsequent period of extended operation or no later than the last refueling outage prior to the subsequent period of extended operation.

Table A4.0-1 Subsequent License Renewal Commitments

#	Program	Commitment	AMP	Implementation
16	*Fire Water System* program	12. The program will be revised to require inspections and tests be performed by personnel qualified in accordance with site procedures and programs for the specified task. (Added Change Notice 2) 13. Procedures will be revised to require when degraded coatings are detected by internal coating inspections, acceptance criteria and corrective action recommendations consistent with the Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers and Tanks (B2.1.28) program are followed in lieu of NFPA 25 section 9.2.7 (1), (2), and (4). When interior pitting or general corrosion (beyond minor surface rust) is detected, tank wall thickness measurements are conducted as stated in NFPA 25 Section 9.2.7(3) in vicinity of the loss of material. Vacuum box testing as stated in NFPA 25 Section 9.2.7(5) is conducted when pitting, cracks, or loss of material is detected in the immediate vicinity of welds. (Added Change Notice 2) 14. Procedures will be revised to address recurring internal corrosion with the use of Low Frequency Electromagnetic Technique (LFET) or a similar technique on 100 feet of piping during each refueling cycle to detect changes in the pipe wall thickness. LFET screening or a similar technique will also be performed on accessible interior fire water storage tank bottoms during periodic inspections. The procedure will specify thinned areas found during the LFET screening be followed up with pipe wall thickness examinations to ensure aging effects are managed and wall thickness is within acceptable limits. In addition to the pipe wall thickness examination, the performance of opportunistic visual inspections of the fire protection system will be required whenever the fire water system is opened for maintenance.	B2.1.16	Program will be implemented and inspections or tests begin 5 years before the subsequent period of extended operation. Inspections or tests that are to be completed prior to the subsequent period of extended operation are completed 6 months prior to the subsequent period of extended operation or no later than the last refueling outage prior to the subsequent period of extended operation.

Table A4.0-1 Subsequent License Renewal Commitments

#	Program	Commitment	AMP	Implementation
34	*Structures Monitoring* program	The *Structures Monitoring* program is an existing condition monitoring program that will be enhanced as follows: 1. Procedures will be revised to include inspection of the following structures that are within the scope of subsequent license renewal: decontamination building, radwaste facility, health physics yard office building, laundry facility, and machine shop. Inspections for the added structures will be performed under the enhanced program in order to establish quantitative baseline inspection data prior to the subsequent period of extended operation. (Revised Change Notice 1) 2. Procedures will be revised to add the oiled-sand cushion to the inspection of the fire protection/domestic water tank foundation.(Added Change Notice 3) 3. Procedures will be revised to include preventive actions to ensure bolting integrity for replacement and maintenance activities by specifying proper selection of bolting material and lubricants, and appropriate installation torque or tension to prevent or minimize loss of bolting preload and cracking of high-strength bolting. For structural bolting consisting of ASTM A325, ASTM A490, ASTM F1852 and/or ASTM F2280 bolts, the preventive actions for storage, lubricant selection, and bolting and coating material selection discussed in Section 2 of the Research Council for Structural Connections publication, "Specification for Structural Joints Using High-Strength Bolts," will be used. 4. The checklist for structural and support steel will be revised to indicate: "Are any connection members loose, missing or damaged (bolts, rivets, nuts, etc.)?". (Added Change Notice 2) 5. ~~Procedures will be revised to require at least five years of experience (or ACI inspector certification) for concrete inspectors to be consistent with ACI 349.3R-002.~~ Procedures will be revised to require at least five years of experience (or ACI inspector certification) for concrete inspectors to be consistent with ACI 349.3R-002. Procedures will be revised to eliminate options for inspector qualifications that are not consistent with ACI 349.3R-002.(Revised Change Notice 2) 6. ~~Procedures will be revised to inspect wooden power poles on a 10-year frequency.~~ Procedures will be revised to specify that wooden pole inspections will be performed every ten years by an outside firm that provides wooden pole inspection services that are consistent with standard industry practice. Visual examinations may be augmented with soundings or other techniques appropriate for the type, condition, and treatment of the wooden poles, including borings to determine the location and extent of decay and excavation to determine the extent of decay at the groundline. (Revised Change Notice 2) 7. Procedures will be revised to specify that evaluation of inspection results includes consideration of the acceptability of inaccessible areas when conditions exist in accessible areas that could indicate the presence of, or result in, degradation to such inaccessible areas. (Added Change Notice 2) 8. Procedures will be enhanced to specify VT-1 inspections to identify cracking on stainless steel and aluminum components. A minimum of 25 inspections will be performed every ten years during the subsequent period of extended operation from each of the stainless steel and aluminum component populations assigned to the Structures Monitoring program. If the component is measured in linear feet, at least one foot will be inspected to qualify as an inspection. For other components, at least 20% of the surface area will be inspected to qualify as an inspection. The selection of components for inspection will consider the severity of the environment. For example, components potentially exposed to halides and moisture would be inspected, since those environmental factors can facilitate stress corrosion cracking. (Added Change Notice 2)	B2.1.34	Program enhancements for SLR will be implemented 6 months prior to the subsequent period of extended operation.

Table A4.0-1 Subsequent License Renewal Commitments

#	Program	Commitment	AMP	Implementation
		9. Procedures will be enhanced to specify for the sampling-based inspections to detect cracking in stainless steel and aluminum components, additional inspections will be conducted if one of the inspections does not meet acceptance criteria due to current or projected degradation, unless the cause of the aging effect for each applicable material and environment is corrected by repair or replacement for all components constructed of the same material and exposed to the same environment. No fewer than five additional inspections for each inspection that did not meet acceptance criteria or 20 percent of each applicable material, environment, and aging effect combination will be inspected, whichever is less. Additional inspections will be completed within the 10-year inspection interval in which the original inspection was conducted. The responsible engineer will initiate condition reports to generate work orders to perform the additional inspections. The responsible engineer will evaluate the inspection results, and if the subsequent inspections do not meet acceptance criteria, an extent of condition and extent of cause analysis will be conducted. The responsible engineer will then determine the further extent of inspections. Additional samples will be inspected for any recurring degradation to ensure corrective actions appropriately address the associated causes. The additional inspections will include inspections of components with the same material, environment, and aging effect combination at both Unit 1 and Unit 2. If any projected inspection results will not meet acceptance criteria prior to the next scheduled inspection, inspection frequencies will be adjusted as determined by the Corrective Action Program. (Added Change Notice 2) 10. Procedures will be enhanced to specify that evaluation of neutron shield tank findings consider its structural support function for the reactor pressure vessel. (Added Change Notice 3) 11. Procedures will be enhanced to also include LOCAs as events that require evaluation for potentially degraded structures by Civil/Mechanical Design Engineering. (Added Change Notice 3)		
35	*Inspection of Water Control Structures Associated with Nuclear Power Plants* program	The *Inspection of Water Control Structures Associated with Nuclear Power Plants* program is an existing condition monitoring program that will be enhanced as follows: 1. Procedures will be revised to provide guidance for specification of bolting material, lubricants and sealants, and installation torque or tension to prevent degradation and assure structural bolting integrity. 2. Procedures will be revised to specify the preventive actions for storage discussed in Section 2 of Research Council for Structural Connections publication "Specification for Structural Joints Using ASTM A325 or A490 Bolts" for ASTM A325, ASTM F1852, ASTM F2280, and/or ASTM A490 structural bolts. 3. Procedures will be revised for concrete inspection to require at least five years of experience (or ACI inspector certification) to be consistent with ACI 349.3R-2002.	B2.1.35	Program enhancements for SLR will be implemented 6 months prior to the subsequent period of extended operation.

B2.1.16 Fire Water System

Program Description

The *Fire Water System* program is an existing condition monitoring program that manages loss of material, flow blockage, cracking and loss of coating integrity for in-scope water-based fire protection systems. This program manages aging effects by conducting periodic visual inspections, flow testing, and flushes. Testing and inspections are conducted on a refueling outage interval as allowed by NUREG-2191, Section XI.M27, Table XI.M27-1, "Fire Water System Inspection and Testing Recommendations". There are no nozzle strainers, glass bulb sprinklers, fire pump suction strainers, or foam water sprinkler systems within the scope of subsequent license renewal.

The *Fire Water System* program will include testing a representative sample of the sprinklers prior to fifty years in service with additional representative samples tested at 10-year intervals. Sprinkler testing will be performed consistent with the 2011 Edition of NFPA 25, "Standard For The Inspection, Testing and Maintenance of Water-Based Fire Protection Systems," Section 5.3.1. The fifty year in-service date for sprinklers is October 26, 2021.

Portions of water-based fire protection system components that have been wetted, but are normally dry, such as dry-pipe or preaction sprinkler system piping and valves, were designed and installed with a configuration and pitch to allow draining. With the exception of two locations, Engineering walkdowns confirmed the as-built configuration that allows draining and does not allow water to collect. Corrective actions have been initiated for the two locations to verify a flow blockage condition does not exist and to restore the two locations to original configuration requirements that allow draining and do not allow water to collect. After corrective actions, portions of the water-based fire protection system that have been wetted, but are normally dry, will not be subjected to augmented testing and inspections beyond those required by NUREG-2191, AMP XI.M27, Table XI.M27-1.

The water-based fire protection system is normally maintained at required operating pressure and is monitored such that loss of system pressure is detected and corrective actions initiated. A low pressure condition is alarmed in the Main Control Room by the auto start of the electric motor driven fire pump, followed by the start of the diesel-driven fire pump if the low pressure condition continues to exist. The status of the fire pumps is indicated in the Main Control Room and at the fire pump control panels in the pump house. Both fire pumps may be manually started from the control room.

Piping wall thickness measurements are conducted when visual inspections detect surface irregularities indicative of unexpected levels of degradation. When the presence of organic or inorganic material sufficient to obstruct piping or sprinklers is detected, the material is removed and the source is detected and corrected.

Inspections and tests are performed by personnel qualified in accordance with procedures and programs to perform the specified task. Non-code inspections and tests follow procedures that include inspection parameters for items such as lighting, distance, offset, presence of protective coatings, and cleaning processes that ensure an adequate examination.

If a flow test (i.e., NFPA 25, 2011 Edition, Section 6.3.1) or a main drain test (i.e., NFPA 25, 2011 Edition, Section 13.2.5) does not meet the acceptance criteria due to current or projected degradation, additional tests are conducted. The number of increased tests is determined in accordance with the site's corrective action process; however, there are no fewer than two additional tests for each test that did not meet the acceptance criteria. The additional inspections are completed within the interval (i.e., five years or annual/refueling) in which the original test was conducted. If subsequent tests do not meet the acceptance criteria, an extent of condition and extent of cause analysis is conducted to determine the further extent of tests required. The additional tests will include at least one test at the other unit on site with the same material, environment, and aging effect combination.

In addition to piping replacement, actions will be taken to address instances of recurring corrosion due to microbiological induced corrosion. Low Frequency Electromagnetic Technique (LFET) or similar scanning technique will be used for screening 100 feet of accessible piping during each refueling cycle to detect changes in the wall thickness of the pipe. Thinned areas found during the LFET scan are followed up with pipe wall thickness examinations to ensure aging effects are managed and that wall thickness is within acceptable limits. In addition to the pipe wall thickness examination, opportunistic visual inspections of the fire protection system will be performed whenever the fire water system is opened for maintenance.

Aging of the external surfaces of buried and underground fire main piping is managed by the *Buried and Underground Piping and Tanks* program (B2.1.27). Loss of material and cracking of the internal surfaces of cement lined buried and underground fire main piping are managed by the *Internal Coatings/Linings For In-Scope Piping, Piping Components, Heat Exchangers, and Tanks* program (B2.1.28).

Aging of the fire water storage tank bottom surfaces exposed to oil soil are managed by the *Outdoor and Large Atmospheric Metallic Storage Tanks* program (B2.1.17).

When degraded coatings are detected during internal inspections of the fire water storage tanks, acceptance criteria, and corrective action recommendations of the *Internal Coatings/Linings For In-Scope Piping, Piping Components, Heat Exchangers, and Tanks* program (B2.1.28) are followed. The training and qualification of individuals involved in coating/lining inspections of non-cementitious coatings/linings are conducted in accordance with ASTM International Standards endorsed in RG 1.54 including guidance from the staff associated with a particular standard.

NUREG-2191 Consistency

The *Fire Water System* program is an existing program that, following enhancement, will be consistent, with exception, to NUREG-2191, Section XI M27, Fire Water System.

Exception Summary

The following program element(s) are affected:

~~Detection of Aging Effects (Element 4)~~

1. (Deleted exception for fire water storage tanks insulated external surface inspections - Change Notice 3) ~~The fire water storage tanks are insulated carbon steel tanks located in an outdoor environment. NUREG-2191, AMP XI.M27, Table XI.M27-1 and note 10 recommends the insulated external surfaces of fire water storage tanks be inspected for signs of degradation on a refueling outage interval for signs of degradation. This would require insulation removal each refueling cycle. Therefore, inspections of the external carbon steel surfaces of the fire water storage tanks will be performed on a 10-year frequency during the subsequent period of operation.~~

~~Justification for Exception:~~

~~The line item in NUREG-2191, Section XI.M27, Table XI.M27-1, for water storage tank external surfaces recommends the inspection guidance of NFPA, 2011 Edition, Section 9.2.5.5, which requires inspection of insulated tank surfaces. NFPA, 2011 Edition, Section 9.2.5.5, does not provide specific inspection guidance for corrosion of metallic surfaces under insulation in an outdoor air environment. NUREG-2191, Section XI.M29, Outdoor and Large Atmospheric Metallic Storage Tanks, element 4, provides inspection guidance for corrosion under insulation for insulated carbon steel tanks located in an outdoor environment. NUREG-2191, Section XI.M29, Table XI.M29-1, recommends a 10-year frequency for corrosion under insulation during the subsequent period of operation.~~

2. NUREG-2191, Table XI.M27-1, note 10 recommends main drain tests at each water-based system riser to determine if there is a change in the condition of the water piping and control valves on an annual or refueling outage interval. Surry Power Station will perform the main drain tests on twenty percent of the standpipes and risers every refueling cycle.

Justification for Exception

As indicated by NUREG-2191 Table XI.M27-1, note 10, access for some inspections is feasible only during refueling outages which are scheduled every eighteen months. Main drain tests on twenty percent of the standpipes and risers every eighteen months provide adequate information to determine the condition of the fire water piping is maintained consistent with the design basis.

Enhancements

Prior to the subsequent period of extended operation, the following enhancement(s) will be implemented in the following program element(s):

Parameters Monitored or Inspected (Element 3), Detection of Aging Effects (Element 4), Acceptance Criteria (Element 6), and Corrective Actions (Element 7)

1. (Sprinkler inspections - Completed Change Notice 1)
2. Prior to 50 years in service, sprinkler heads will be submitted for field-service testing by a recognized testing laboratory consistent with NFPA 25, 2011 Edition, Section 5.3.1. Additional representative samples will be field-service tested every 10 years thereafter to ensure signs of aging are detected in a timely manner.

   For wet pipe sprinkler systems, a one-time test of sprinklers that have been exposed to water including the sample size, sample selection criteria, and minimum time in service of tested sprinklers will be performed. At each unit, a sample of 3% or a maximum of ten sprinklers with no more than four sprinklers per structure shall be tested. Testing is based on a minimum time in service of fifty years and severity of operating conditions for each population. (Revised - Change Notice 2)
3. Procedures will be revised to specify:
   a. Standpipe and system flow tests for hose stations at the hydraulically most limiting locations for each zone of the system on a five year interval to demonstrate the capability to provide the design pressure at required flow.
   b. Acceptance criteria for wet pipe main drain tests. Flowing pressures from test to test will be monitored to determine if there is a 10% reduction in full flow pressure when compared to previously performed tests. The Corrective Action Program will determine the cause and necessary corrective action.
   c. If a flow test or a main drain test does not meet acceptance criteria due to current or projected degradation additional tests are conducted. The number of increased tests is determined in accordance with the corrective action process; however, there are no fewer than two additional tests for each test that did not meet acceptance criteria. The additional inspections are completed within the interval in which the original test was conducted. If subsequent tests do not meet acceptance criteria, an extent of condition and extent of cause analysis is conducted to determine the further extent of tests. The additional tests include at least one test at the other unit with the same material, environment, and aging effect combination.
   d. Main drains for the standpipes associated with hose stations within the scope of subsequent license renewal will also be added to main drain testing procedures.

4. Procedures will be revised to perform internal visual inspections of sprinkler and deluge system piping to identify internal corrosion, foreign material, and obstructions to flow. Follow-up volumetric examinations will be performed if internal visual inspections detect an unexpected level of degradation due to corrosion product deposition. If organic or foreign material, or internal flow blockage that could result in failure of system function is identified, then an obstruction investigation will be performed within the Corrective Action Program that includes removal of the material, an extent of condition determination, review for increased inspections, extent of follow-up examinations, and a flush in accordance with NFPA 25, 2011 Edition, Annex D.5, Flushing Procedures. The internal visual inspections will consist of the following: (Relocated from Enhancement 10 and Corrected - Change Notice 2)

   a. Wet pipe sprinkler systems - 50% of the wet pipe sprinkler systems in scope for subsequent license renewal will have visual internal inspections of piping by removing a hydraulically remote sprinkler, performed every five years, consistent with NFPA 25, 2011 Edition, Section 14.2. During the next five-year inspection period, the alternate systems previously not inspected shall be inspected.

   b. Pre-action sprinkler systems - pre-action sprinkler systems in scope for subsequent license renewal will have visual internal inspections of piping by removing a hydraulically remote nozzle, performed every five years, consistent with NFPA 25, 2011 Edition, Section 14.2.

   c. Deluge systems - deluge systems in scope for subsequent license renewal will have visual internal inspections of piping by removing a hydraulically remote nozzle, performed every five years, consistent with NFPA 25, 2011 Edition, Section 14.2.

Parameters Monitored or Inspected (Element 3), Detection of Aging Effects (Element 4), and Monitoring and Trending (Element 5)

5. Procedures will be revised to perform system flow testing at flows representative of those expected during a fire. A flow resistance factor (C-factor) will be calculated to compare and trend the friction loss characteristics to the results from previous flow tests. (Renumbered - Change Notice 2)

Parameters Monitored or Inspected (Element 3) and Detection of Aging Effects (Element 4)

6. (Hydrant flushing Completed - Change Notice 1 and renumbered - Change Notice 2)

7. Prior to the subsequent period of extended operation, the insulation on the exterior surfaces of the fire water storage tanks (FWSTs) will be permanently removed. Wall thickness measurements will be performed on external tank areas exhibiting unexpected degradation. Refurbishment/recoating will be performed consistent with the severity of the degradation identified and commensurate with the potential for loss of intended function. Inspections of external tank surfaces will be on a refueling cycle frequency. ~~The *Fire Water System* program~~

will be revised to periodically inspect the insulated exterior surfaces of the fire water tanks on a 10 year frequency during the subsequent period of operation. Insulation is removed to provide a minimum inspection population of 25 one-square foot samples. The samples will be distributed in such a way that inspections occur on the tank dome, near the tank bottom, at points where structural supports, pipe, or instrument nozzles penetrate the insulation and where water could collect. In addition, inspection locations will be based on the likelihood of corrosion under insulation occurring.(Renumbered - Change Notice 2 and revised - Change Notice 3)

8. (Strainer flushing Ccompleted - Change Notice 1 and renumbered - Change Notice 2)

9. A procedure will be created to provide a Turbine Building oil deluge systems spray nozzle air flow test to ensure that patterns are not impeded by plugged nozzles, to ensure that nozzles are correctly positioned, and to ensure that obstructions do not prevent discharge patterns from wetting surfaces to be protected. (Renumbered - Change Notice 2)

(Old Enhancement #9 was Rrelocated to Enhancement 4 - Change Notice 2)

Detection of Aging Effects (Element4)

10. Procedure will be revised to provide inspection guidance related to lighting, distance and offset for non-ASME Code inspections. The procedure will specify adequate lighting be verified at the inspection location to detect degradation. Lighting may be permanently installed, temporary, or portable (e.g., flashlight), as appropriate. For accessible surface inspections, inspecting from a distance of two to four feet (or less) will be appropriate. For distant surface inspections, viewing aids such as binoculars may be used. For viewing angles which may prevent adequate inspection, a viewing aid such as an inspection mirror or boroscope should be used.

11. The Unit 1 hydrogen seal oil system deluge sprinkler pipe and Unit 1 station main transformer '1A' deluge sprinkler piping will be reconfigured to allow drainage. As part of the drainage reconfiguration, visual inspections and wall thickness measurements will be performed on the Unit 1 hydrogen seal oil system deluge sprinkler pipe that does not drain. In addition, wall thickness examination of the Unit 1 main transformer deluge sprinkler piping that does not allow drainage will also be performed as part of the drainage reconfiguration. Piping with unexpected degradation will be replaced. (Revised – Change Notice 3)

12. The program will be revised to require inspections and tests be performed by personnel qualified in accordance with site procedures and programs for the specified task. (Added Change Notice 2)

13. Procedures will be revised to require when degraded coatings are detected by internal coating inspections, acceptance criteria and corrective action recommendations consistent with the Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers and

Tanks (B2.1.28) program are followed in lieu of NFPA 25 section 9.2.7 (1), (2), and (4). When interior pitting or general corrosion (beyond minor surface rust) is detected, tank wall thickness measurements are conducted as stated in NFPA 25 Section 9.2.7(3) in vicinity of the loss of material. Vacuum box testing as stated in NFPA 25 Section 9.2.7(5) is conducted when pitting, cracks, or loss of material is detected in the immediate vicinity of welds. (Added Change Notice 2)

Detection of Aging Effects (Element4) and Acceptance Criteria (Element 6)

14. Procedures will be revised to address recurring internal corrosion with the use of Low Frequency Electromagnetic Technique (LFET) or a similar technique on 100 feet of piping during each refueling cycle to detect changes in the pipe wall thickness. LFET screening or a similar technique will also be performed on accessible interior fire water storage tank bottoms during periodic inspections. The procedure will specify thinned areas found during the LFET screening be followed up with pipe wall thickness examinations to ensure aging effects are managed and wall thickness is within acceptable limits. In addition to the pipe wall thickness examination, the performance of opportunistic visual inspections of the fire protection system will be required whenever the fire water system is opened for maintenance.

Operating Experience Summary

The following examples of operating experience provide objective evidence that the *Fire Water System* program has been, and will be effective in managing the aging effects for SSCs within the scope of the program so that their intended functions will be maintained consistent with the current licensing basis during the subsequent period of extended operation.

1. In January 2012, an Engineering walkdown of the fire protection piping header along the north wall of the Unit 2 Turbine Building revealed a potential leak location on the supply line to a hose rack. The flanged connection and straight pipe were removed and replaced.
2. In January 2012, a section of 2-inch fire protection "drop" piping in the Turbine Building developed a leak. The investigation for extent of condition and determination for the extent of fire protection piping to be inspected and replaced, as necessary, involved inspections of three locations in the Turbine Building and three locations in the Auxiliary Building. Microbiologically induced corrosion (MIC) was evident in many locations, but the extent of corrosion was not as severe in the Auxiliary Building as it was in the Turbine Building. Despite the less severe corrosion in the Auxiliary Building, the three segments of piping that were inspected were replaced. Similarly, one of the three segments of piping in the Turbine Building was replaced.

   A capital project was proposed for a multi-year process of replacing segments of 2-inch, 4-inch, and 10-inch piping in the Turbine Building. The initial phase that was completed included replacing 200 feet of ten inch piping in the Turbine Building. Additional phases were proposed, and described in the Fire Protection Strategic Plan. See April 2013 and November 2015 operating experience.

3. In June 2012, during inspection of Auxiliary Building fire protection piping minor sediment was discovered in the supply header to the Unit 1 cable tunnel sprinklers. Debris and MIC nodules were discovered inside a spool piece and accessible four inch piping. The sediment and debris were removed, the visual inspection was performed, and the blind flanges and spool pieces were replaced. The necessary pipe replacement is included in the Fire Protection Strategic Plan.
4. In March 2013, NRC Information Notice 13-06, "Corrosion in Fire Protection Piping Due to Air and Water Interaction", identified industry operating experience involving the loss of function of fire protection water systems due to the potential for adverse air and water interactions in pre-action and dry-pipe systems. Engineering evaluated the potential for similar adverse conditions and associated degradation in deluge systems at Surry Power Station that are periodically flow tested. Subsequently, in January 2018, a walkdown was performed to confirm that plant design specifications on drainage features for piping downstream of all in-scope pre-action and deluge valves in the fire protection system continued to be in effect. Two locations, one relating to main transformer 1A and one relating to Unit 1 generator hydrogen seal oil system, were identified as having a potential for adverse air and water interactions and entered into the corrective action program.
5. In April 2013, a section of two 10-inch fire protection system piping in the Turbine Building developed a leak. A walkdown of six locations was performed to determine extent of condition in the Turbine Building and the Auxiliary Building. MIC was evident in four locations, but the extent of corrosion in the Auxiliary Building was not as severe. Replacement of 4-inch and 10-inch fire protection header is a like-for-like replacement. The replacement of the Turbine Fire Protection Header was split into four different phases. One phase was to be accomplished each year. The second phase is planned to replace approximately 400 feet of ten-inch header pipe and 200 feet of two-inch hose station pipe. The necessary pipe replacement is included in the Fire Protection Strategic Plan.
6. In February 2014, visual and volumetric inspections were performed for Fire Protection/domestic water storage tank 1A to determine the extent of additional degradation that had occurred since similar inspections were completed in December 2008. The most significant degradation was noted on the tank floor. The result of the visual inspection was that coating degradation was continuing, and that some bare metal was evident. Similarly, volumetric examinations found additional thinning for the tank floor. ~~An engineering evaluation projected that the tank floor plate would reach minimum acceptable thickness prior to the expiration of the Unit 2 renewed operating license. Monitoring of the tank floor will continue until the tank floor is repaired or replaced. The necessary tank repair or replacement is included in the Fire Protection Strategic Plan.~~ Follow-up visual examinations were performed in August 2018 and follow-up wall thickness examinations were performed in March 2019. Prior wall thickness measurements were confirmed to be attributed to laminations that existed from original steel plate fabrication. An engineering evaluation projected the tank floor plate

would maintain acceptable wall thickness thoughout the subsequent period of extended operation. Work orders were generated to refurbish/recoat the FWST interior surfaces prior to the subsequent period of extended operation.

7. In August 2014, visual and volumetric inspections were performed for Fire Protection/domestic water storage tank 1B to determine the extent of additional degradation that had occurred since similar inspections were completed in December 2008. The most significant degradation was noted on the tank floor. ~~The result of the visual inspection was that coating degradation was continuing, and that some bare metal was evident. Volumetric examinations found some thinning of the tank floor. An engineering evaluation projected that the tank floor plate would reach minimum acceptable thickness prior to the expiration of the Unit 2 renewed operating license. Monitoring of the tank floor will continue until the tank floor is repaired or replaced.~~Follow-up visual examinations were performed in August 2018 and follow-up wall thickness examinations were performed in March 2019. Prior wall thickness measurements were confirmed to be attributed to laminations that existed from original steel plate fabrication. An engineering evaluation projected the tank floor plate would maintain acceptable wall thickness thoughout the subsequent period of extended operation. Work orders were generated to refurbish/recoat the FWST interior surfaces prior to the subsequent period of operation.

8. In September 2014, a materials analysis was performed on buried cement lined grey cast iron fire main piping that was fractured during flow testing of hose station valves. The fracture was attributed to a latent material defect in the cast iron. The piping was removed and replaced with an equivalent spool piece. Based on the oxidation along the top segment of the crack, the pipe was cracked for a long period of time. High levels of calcium deposits on the fracture (from the cement lining) indicate that the pipe was partially cracked at the top segment before factory installation of the cement liner (manufacturing process). Material analysis of the pipe determined that the microstructure consisted of graphite flakes that were approximately 75% ferrite and 25% pearlite. This resulted in a reduction in the supplied material hardness. Failure of pipe was not preventable through maintenance. The failure was caused by ground settling. During the pipe replacement it was observed that there was vertical misalignment between the replacement pipe and the existing buried pipe, which indicated that the buried side piping was exerting a large bending load at the anchor/foundation. This bending load along with the pre-existing crack and lower hardness value caused the pipe fracture. The balance of the failed pipe was found in good condition with no significant loss of cement lining material, corrosion, cracking, fouling, or reduction of pipe interior diameter.

9. In November 2015, an effectiveness review of the Fire Protection Program aging management activity (AMA) (UFSAR Section 18.2.7) was performed. The AMA was evaluated against the performance criteria identified in NEI 14-12 for the Detection of Aging Effects, Corrective Actions, and Operating Experience program elements. A comprehensive fire water system assessment recommended a large scale piping replacement of turbine building and auxiliary

building piping. The large scale piping replacement project to be performed over multiple refueling outages was identified as a measure to address degradation in carbon steel system piping and to ensure that system intended functions were maintained. Completed and closed phases of this effort have included replacement of approximately 400 feet of 4 inch piping and 200 feet of 2 inch piping in 2014 and approximately 567 feet of 4 inch piping and 303 feet of 2 inch piping in 2015. An additional phase replacing approximately 175 feet of 4 inch piping and 100 feet of 2 inch piping has been completed and is awaiting final testing. Work documents for additional phases are planned and issued for work extending into 2019.

10. In ~~April 2016,~~ March 2019, results from fire protection system 2500 gpm flow tests with the motor driven fire pump ~~in April 2016, July 2013, and April 2010~~ from 2014 through 2019 consistently showed ~~that the~~satisfactory system pressure ~~is higher than the required value~~ for the corresponding flow rate. ~~In 2016, the result indicated that the measured pressure exceeded the required pressure by fourteen psi. In 2013, the measured pressure was thirteen psi higher than required. The result in 2010 measured a pressure that was 19 psi higher than required.~~ The trend from these results does not indicate significant degradation over the ~~six~~five-year interval, particularly considering the two most recent measurements. Results from fire protection system 2500 gpm flow tests with the diesel driven fire pump from 2014 through 2019 also consistently showed satisfactory system pressure for the corresponding flow rate. There is confidence that continued implementation of flow monitoring for the fire protection system using the three year interval required by the Technical Requirements Manual will effectively manage aging prior to a loss of intended function.

11. In December 2016, as part of oversight review activities, a review of procedures credited by initial license renewal AMAs was conducted to confirm the following:
    - Procedures credited for license renewal were identified
    - Procedures were consistent with the licensing basis and bases documents
    - Procedures contained a reference to conduct an aging management review prior to revising
    - Procedures credited for license renewal were identified by an appropriate program indicator and contained a reference to a license renewal document

    Procedure changes were completed as necessary to ensure the above items were satisfied.

12. In November 2017, as part of oversight reviews of the Fire Protection Program AMA (UFSAR Section 18.2.7), an inconsistency was identified in the performance interval for system integrity demonstration by main drain testing. The test interval had been extended from quarterly to each 18 months but the extended interval had not been incorporated into program documents. An Engineering Assignment to review operating experience to trended performance data to 2011 has been completed with no significant degrading trends observed. The new interval is

consistent with the test interval of NFPA 25 (2011 Edition) Table 13.1.1.2 modified by NUREG-2191, Section XI.M27, Table XI.M27-1, Note 10.

13. In January 2018 an aging management program effectiveness review was performed for the Fire Protection Program AMA (UFSAR Section 18.2.7). Information from the summary of that effectiveness review is provided below:

    The Fire Protection Program AMA is meeting or exceeding the requirements of selected NEI 14-12, "Aging Management Program Effectiveness," elements. Key activities of the Fire Protection Program AMA that were reviewed include the inspection of components, the evaluation of inspection results, repairs/replacements, corrective actions, and AMA document updates. Engineering reports from 2006 to 2017 of inspections results were reviewed to confirm inspection frequencies were conducted at appropriate intervals and corrective actions taken consistent with the observed aging degradation. The review also included pertinent issues found in the Corrective Action Program from 2006 through 2017 for age related degradation of fire protection components within the scope of license renewal.

    In the past, multiple fire water piping leaks had been identified in the Unit 1 and Unit 2 Turbine Buildings. As a result, a five phase large scale fire protection piping replacement project has been underway since 2015 to replace Turbine Building header piping and hose station piping as well as the Unit 1 and Unit 2 Auxiliary Building Hose station piping. Two of the Turbine Building phases are complete and two are waiting on testing. Phase five includes the remaining scope in the turbine building and the entire scope in the Auxiliary Building and is planned to start in 2018. Once complete, a large majority of the above ground fire protection piping in the plant will have been replaced, including areas where reoccurring leaks were previously identified.

    The fire water/domestic water storage tanks are managed by the Tank Inspection Activities AMA (UFSAR Section 18.1.3); but, are also discussed here for overall fire protection performance considerations. The fire water/domestic water storage tanks were found to have failing internal coatings and loss of material on the tank floors. Estimates for projected useable tank lifetime and evaluations for additional monitoring were performed. Recommendations are being prepared for repair or replacement project considerations.

    Multiple operating issues, and obsolescence of the diesel driven fire pump resulted in a design change that replaced the diesel driven fire pump and associated control panel. The new diesel driven fire pump has exhibited substantially improved performance compared to the original fire pump.

    Activities to implement NFPA 25, 1998 Edition, Section 2-3.1.1 (1998 edition), testing of sprinklers that have been in service for fifty years have been initiated to prove continued functionality. The Unit 1 and Unit 2 turbine building sprinklers have been sampled and will be tested by 2021, when fifty years of service is reached.

Recurring Internal Corrosion (RIC)

Recurring internal corrosion, including through-wall failures due to microbiological induced corrosion, has occurred on several occasions. Periodic fire protection system piping flushes, flow testing and piping thickness measurements will be performed to identify pipe degradation prior to loss of system intended function. Periodic visual inspections and tank bottom thickness measurements are performed on the fire water storage tanks. In addition to recent piping replacements in the Turbine Building and the Auxiliary Building to address instances of RIC due to microbiologically-influenced corrosion, Low Frequency Electromagnetic Technique (LFET) or a similar technique on 100 feet of piping during each refueling cycle to detect changes in the pipe wall thickness. LFET screening or a similar technique will also be performed on accessible interior fire water storage tank bottoms during periodic inspections. Thinned areas found during the LFET scan are followed-up with pipe wall thickness examinations to ensure aging effects are managed and that wall thickness is within acceptable limits. In addition to the pipe wall thickness examination, opportunistic visual inspections of the fire protection system will be performed whenever the fire water system is opened for maintenance.

The above examples of operating experience provides objective evidence that the *Fire Water System* program includes activities to perform periodic fire main and hydrant inspections and flushing, sprinkler inspections, functional test, and flow tests to identify loss of material, flow blockage, and loss of coating integrity for in-scope water-based fire protection systems within the scope of subsequent license renewal, and to initiate corrective actions. Occurrences identified under the *Fire Water System* program are evaluated to ensure there is no significant impact to the safe operation of the plant and corrective actions will be taken to prevent recurrence. Appropriate guidance or corrective actions for additional inspections, re-evaluation, repairs, or replacements is provided for locations where aging effects are found. The program is informed and enhanced when necessary through the systematic and ongoing review of both plant-specific and industry operating experience. There is reasonable assurance that the continued implementation of the *Fire Water System* program, following enhancement, will effectively identify aging, and initiate corrective actions, prior to a loss of intended function.

Conclusion

The continued implementation of the *Fire Water System* program, following enhancement, will provide reasonable assurance that aging effects will be managed such that the components within the scope of this program will continue to perform their intended functions consistent with the current licensing basis during the subsequent period of extended operation.

B2.1.33 Masonry Walls

Program Description

The *Masonry Walls* program is an existing condition monitoring program that manages loss of material, cracking, and loss of material (spalling and scaling) for masonry walls. The *Masonry Walls* program is implemented as part of the *Structures Monitoring* program (B2.1.34).

The *Masonry Walls* program consists of inspections, consistent with IE Bulletin 80-11 (IEB 80-11), "Masonry Wall Design," and plant-specific monitoring proposed by IN 87-67, "Lessons Learned from Regional Inspections of Licensee Actions to IE Bulletin 80-11," for managing shrinkage, separation, gaps, loss of material and cracking of masonry walls such that the evaluation basis is not invalidated and intended functions are maintained. The *Masonry Walls* program relies on periodic visual inspections, conducted by qualified personnel at a frequency not to exceed five years, to monitor and maintain the condition of masonry walls within the scope of subsequent license renewal so that the established evaluation basis for each masonry wall remains valid during the subsequent period of extended operation.

Qualifications for personnel performing inspections and evaluations are consistent with ACI 349.3R-02, "Evaluation of Existing Nuclear Safety-Related Concrete Structures". Inspections are performed and results evaluated consistent with applicable industry documents to ensure that a loss of intended function does not occur. Conditions found to impact the intended function of the masonry wall or invalidate its evaluation basis are documented and entered into the Corrective Action Program for evaluation which will result in analysis, repair or replacement.

Masonry walls that are considered fire barriers are also managed by the *Fire Protection* program (B2.1.15). Steel elements of masonry walls are visually inspected by the *Structures Monitoring* program (B2.1.34).

NUREG-2191 Consistency

The *Masonry Walls* program is an existing program that, following enhancement, will be consistent with NUREG-2191, Section XI.S5, Masonry Walls.

Exception Summary

None

Enhancements

Detection of Aging Effects (Element 4)

1. Procedures will be revised to clarify qualifications for personnel performing inspections of masonry walls and concrete to be consistent with ACI 349.3R-02.

Monitoring and Trending (Element 5), Acceptance Criteria (Element 6)

2. Procedures will be revised to explicitly address the trending of inspection results and projection to the next inspection interval. The procedure will be revised to include acceptance criteria for masonry wall inspections that will be used to ensure observed aging effects (cracking, loss of material, or gaps between the structural steel supports and masonry walls) do not invalidate the evaluation basis of the wall or impact its intended function.

Operating Experience Summary

The following examples of operating experience provide objective evidence that the *Masonry Walls* program has been, and will be effective in managing the aging effects for SSCs within the scope of the program so that their intended functions will be maintained consistent with the current licensing basis during the subsequent period of extended operation.

1. In May 2009, during a walkdown of the Unit 1 Normal Switchgear Room a crack was identified around a concrete block wall. Inspection of the opposite side of the wall showed that the same crack existed on the Unit 2 side. The crack was less than 1/8 inch wide on both sides. The crack was repaired by work order, which was completed and accepted on 5/26/2009.
2. In June 2012, while performing inspections, a 0.050 inch crack was observed in the masonry block and mortar of the Unit 1 'A' Fuel Oil Pump House exterior. The crack width decreased to 0.025 inch between the mortar and the masonry as it progressed along the west wall to the south wall. A work order was issued and the wall crack was repaired.
3. In May 2015, an approximate 1/2 inch diameter hole was identified in a masonry block wall which is located between Battery Room 1A and the Unit 1 Emergency Switchgear Room. This wall is a fire barrier wall. The hole did not completely penetrate the block wall and may have been created for an anchor bolt that has since been removed. A work order was submitted and the hole in the block wall was repaired.

The above examples of operating experience provide objective evidence that the *Masonry Walls* program includes activities to perform visual inspections to manage loss of material, cracking, and loss of material (spalling and scaling) for masonry walls within the scope of subsequent license renewal, and to initiate corrective actions. Occurrences identified under the *Masonry Walls* program are evaluated to ensure there is no significant impact to the safe operation of the plant and corrective actions will be taken to prevent recurrence. Guidance or corrective actions for additional inspections, re-evaluation, repairs, or replacements is provided for locations where aging effects are found. The program is informed and enhanced when necessary through the systematic and ongoing review of both plant-specific and industry operating experience. There is reasonable assurance that the continued implementation of the *Masonry Walls* program, following enhancement, will effectively manage aging prior to a loss of intended function.

Conclusion

The continued implementation of the *Masonry Walls* program, following enhancement, will provide reasonable assurance that aging effects will be managed such that the components within the scope of this program will continue to perform their intended functions consistent with the current licensing basis during the subsequent period of extended operation.

B2.1.34 Structures Monitoring

Program Description

The *Structures Monitoring* program is an existing condition monitoring program that manages aging of the structures and components that are within the scope of subsequent license renewal by managing the following aging effects:

- Cracking
- Cracking and distortion
- Cracking, loss of material
- Cracking, loss of bond, and loss of material (spalling, scaling)
- Increase in porosity and permeability, cracking, loss of material (spalling, scaling)
- Loss of material
- Loss of material, loss of form
- Loss of material (spalling, scaling) and cracking
- Loss of material, change in material properties
- Loss of mechanical function
- Loss of preload
- Loss of sealing
- Reduction in concrete anchor capacity
- Reduction of foundation strength and cracking
- Reduction or loss of isolation function

The *Structures Monitoring* program implements the requirements of 10 CFR 50.65, "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," consistent with guidance of U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide (RG) 1.160, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," and Nuclear Management and Resources Council 93-01, "Industry Guidelines for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants". The scope of the *Structures Monitoring* program includes structures and components in the scope of subsequent license renewal. The program relies on periodic visual inspections to monitor and maintain the condition of structures and components within the scope of subsequent license renewal. Inspections are conducted by qualified personnel at a frequency not to exceed five years, except for wooden poles, which will be inspected on a 10-year frequency. The interval between successive recurring inspections may be decreased based on conditions discovered in previous inspections.

Structural monitoring inspections consist primarily of periodic visual examination of accessible structures and components performed by qualified personnel. For concrete and associated components, ACI-349.3R, "Evaluation of Existing Nuclear Safety-Related Concrete Structures," and other applicable industry documents are used as guidance for the inspections, inspector qualifications, and evaluation of inspection results. The inspection program for structural steel is similar to the concrete program and is based on the guidance provided in the AISC Specification for Structural Steel Buildings and Code of Standard Practice. For earthen structures, evaluation of inspection results is performed by a qualified civil/structural engineer.

Procedures will include preventive actions to provide reasonable assurance of structural bolting integrity, as discussed in Electric Power Research Institute (EPRI) documents (such as EPRI NP-5067, "Good Bolting Practices, A Reference Manual for Nuclear Power Plant Maintenance Personnel," and TR-104213, "Bolted Joint Maintenance & Application Guide"), American Society for Testing and Materials (ASTM) standards, and AISC specifications, as applicable.

In order to evaluate the potential of water to cause degradation of inaccessible below-grade concrete, samples of groundwater will be taken at intervals not to exceed five years. The water chemistry is evaluated, and should the results of water testing indicate potentially harmful levels of substances such as chlorides > 500 ppm, sulfates > 1,500 ppm, or a pH < 5.5, inaccessible areas are assessed for aging when aging degradation exists in accessible areas and opportunistically inspected when excavated.

Ground water monitoring has shown the ground water to be non-aggressive, except for one sampling point. In 2007, a sample with a significantly high chloride level was obtained from the Turbine Building sump. Subsequent sample results from this sump have found additional chloride levels above the acceptance limit. An inspection was performed to assess the structure for any degradation that could be attributed to the elevated levels of chloride. The inspection found no evidence of significant degradation. There have been no indications of concrete degradation due to elevated chloride levels anywhere in the plant. Engineering continues quarterly monitoring of the ground water in this sump.

For surfaces provided with protective coatings, observation of the condition of the coating is an effective method for identifying the absence of degradation of the underlying material. Therefore, coatings on structures within the scope of the *Structures Monitoring* program are inspected only as an indication of the condition of the underlying material.

ASME Code, Section XI visual examinations (VT-1) or surface examinations will be conducted to detect cracking of stainless steel and aluminum components exposed to aqueous solutions or air environments containing halides. A minimum sample of 25 inspections will be performed from each of the aluminum and stainless steel component populations every ten years.

If any sampling-based inspections to detect cracking in aluminum and stainless steel do not meet the acceptance criteria, additional inspections will be conducted, unless the cause of the aging effect for each applicable material and environment is corrected by repair or replacement. There will be no fewer than five additional inspections for each inspection that did not meet acceptance criteria, or 20% of each applicable material, environment, and aging effect combination inspected, whichever is less. If any subsequent inspections do not meet acceptance criteria, an extent of condition and extent of cause analysis will be conducted to determine the further extent of inspections required. Additional samples will be inspected for any recurring degradation to ensure corrective actions appropriately address the associated causes. The additional inspections will include inspections of components with the same material, environment, and aging effect combination at both Unit 1 and Unit 2. The additional inspections will be completed within the interval (i.e., 10 year inspection interval) in which the original inspection was conducted. Where practical, the inspections will focus on the bounding or lead components most susceptible to aging because of time in-service, severity of operating conditions, and lowest design margin.

Concrete inspection results are evaluated to identify changes that could be indicative of Alkali-Silica Reaction (ASR) development. If indications of ASR development are identified, the evaluation considers the potential for ASR development in concrete that is within the scope of the *ASME Section XI, Subsection IWL* program (B2.1.30), the *Structures Monitoring* program (B2.1.34), or the *Inspection of Water-Control Structures Associated with Nuclear Power Plants* program (B2.1.35). In 1988, a research study was performed to evaluate the degradation processes that could affect the reinforced concrete structures. Concrete core samples were secured from the intake canal, Unit 1 Condensate Storage Tank Missile Shield, Unit 2 Safeguards Building and Unit 2 Containment. Based on testing of these samples, the study concluded that there was no evidence of ASR.

Evaluation of inspection results includes consideration of the acceptability of inaccessible areas when conditions exist in accessible areas that could indicate the presence of, or result in, degradation to such inaccessible areas.

Structural sealants, seismic gap joint filler, vibration isolation elements, and other elastomeric materials are monitored for cracking, loss of material, and hardening. These elastomeric elements are acceptable if the observed loss of material, cracking, and hardening will not result in a loss of intended function. Visual inspection of elastomeric elements is supplemented by tactile inspection to detect hardening if the intended function is suspect.

Procedures will include preventive actions to ensure bolting integrity for replacement and maintenance activities by specifying proper selection of bolting material and lubricants, and appropriate installation torque or tension to prevent or minimize loss of bolting preload and cracking of high-strength bolting. For structural bolting consisting of ASTM A325, ASTM A490, ASTM F1852 and/or ASTM F2280 bolts, the preventive actions for storage, lubricant selection, and bolting and coating material selection discussed in Section 2 of the Research Council for Structural

Connections publication, "Specification for Structural Joints Using High-Strength Bolts," will be used.

Spent fuel pool (SFP) liner leakage through the leak chase channels is monitored. An alarm is provided on the SFP to sound at a level loss of approximately 0.5 feet (UFSAR Section 9.5.3.3). A review of recent leak chase channel monitoring reports shows acceptable leakage rates with no tell-tale drains being completely blocked.

The *Masonry Walls* program (B2.1.33) and the *Inspection of Water-Control Structures Associated with Nuclear Power Plants* program (B2.1.35) are implemented as part of this program.

NUREG-2191 Consistency

The *Structures Monitoring* program is an existing program that, following enhancement, will be consistent with NUREG-2191, Section XI.S6, Structures Monitoring.

Exception Summary

None

Enhancements

Prior to the subsequent period of extended operation, the following enhancement(s) will be implemented in the following program element(s):

Scope of Program (Element 1)

1. Procedures will be revised to include inspection of the following structures that are within the scope of subsequent license renewal: decontamination building, radwaste facility, health physics yard office building, laundry facility, and machine shop. Inspections for the added structures will be performed under the enhanced program in order to establish quantitative baseline inspection data prior to the subsequent period of extended operation.

2. Procedures will be revised to add the oiled-sand cushion to the inspection of the fire protection/domestic water tank foundation. (Added Change Notice 3)

Preventive Actions (Element 2)

3. Procedures will be revised to include preventive actions to ensure bolting integrity for replacement and maintenance activities by specifying proper selection of bolting material and lubricants, and appropriate installation torque or tension to prevent or minimize loss of bolting preload and cracking of high-strength bolting. For structural bolting consisting of ASTM A325, ASTM A490, ASTM F1852 and/or ASTM F2280 bolts, the preventive actions for storage, lubricant selection, and bolting and coating material selection discussed in Section 2 of the Research Council for Structural Connections publication, "Specification for Structural Joints Using High-Strength Bolts," will be used.

4. The checklist for structural and support steel will be revised to indicate: "Are any connection members loose, missing or damaged (bolts, rivets, nuts, etc.)?".

Detection of Aging Effects (Element 4)

5. Procedures will be revised to eliminate options for inspector qualifications that are not consistent with ACI 349.3R-002.

6. Procedures will be revised to specify that wooden pole inspections will be performed every ten years by an outside firm that provides wooden pole inspection services that are consistent with standard industry practice. Visual examinations may be augmented with soundings or other techniques appropriate for the type, condition, and treatment of the wooden poles, including borings to determine the location and extent of decay and excavation to determine the extent of decay at the groundline.

7. Procedures will be revised to specify that evaluation of inspection results includes consideration of the acceptability of inaccessible areas when conditions exist in accessible areas that could indicate the presence of, or result in, degradation to such inaccessible areas.

8. Procedures will be enhanced to specify VT-1 inspections to identify cracking on stainless steel and aluminum components. A minimum of 25 inspections will be performed every ten years during the subsequent period of extended operation from each of the stainless steel and aluminum component populations assigned to the Structures Monitoring program. If the component is measured in linear feet, at least one foot will be inspected to qualify as an inspection. For other components, at least 20% of the surface area will be inspected to qualify as an inspection. The selection of components for inspection will consider the severity of the environment. For example, components potentially exposed to halides and moisture would be inspected, since those environmental factors can facilitate stress corrosion cracking.

Corrective Actions (Element 7)

9. Procedures will be enhanced to specify for the sampling-based inspections to detect cracking in stainless steel and aluminum components, additional inspections will be conducted if one of the inspections does not meet acceptance criteria due to current or projected degradation, unless the cause of the aging effect for each applicable material and environment is corrected by repair or replacement for all components constructed of the same material and exposed to the same environment. No fewer than five additional inspections for each inspection that did not meet acceptance criteria or 20 percent of each applicable material, environment, and aging effect combination will be inspected, whichever is less. Additional inspections will be completed within the 10-year inspection interval in which the original inspection was conducted. The responsible engineer will initiate condition reports to generate work orders to perform the additional inspections. The responsible engineer will evaluate the inspection results, and if the subsequent inspections do not meet acceptance criteria, an extent of

condition and extent of cause analysis will be conducted. The responsible engineer will then determine the further extent of inspections. Additional samples will be inspected for any recurring degradation to ensure corrective actions appropriately address the associated causes. The additional inspections will include inspections of components with the same material, environment, and aging effect combination at both Unit 1 and Unit 2. If any projected inspection results will not meet acceptance criteria prior to the next scheduled inspection, inspection frequencies will be adjusted as determined by the Corrective Action Program.

10. Procedures will be enhanced to specify that evaluation of neutron shield tank findings consider its structural support function for the reactor pressure vessel. (Added Change Notice 3)

11. Procedures will be enhanced to also include LOCAs as events that require evaluation for potentially degraded structures by Civil/Mechanical Design Engineering. (Added Change Notice 3)

Operating Experience Summary

The following examples of operating experience provide objective evidence that the *Structures Monitoring* program has been, and will be effective in managing the aging effects for SSCs within the scope of the program so that their intended functions will be maintained consistent with the current licensing basis during the subsequent period of extended operation.

1. In March 2007, a condition report (CR) was written to document a ground water monitoring sample with a chloride level of 1210 ppm, which exceeded the acceptance limit of <500 ppm. This sample was obtained from the Turbine Building sump. Corporate and site Engineering continue to monitor the quarterly sample results from the Turbine Building sump and have found additional chloride levels above the acceptance limit, as high as 2700 ppm. An inspection of the Turbine Building sump was performed in July 2008 to assess the sump structure for any degradation that could be attributed to the elevated level of chlorides. The inspection found no evidence of significant degradation to the interior concrete. There are no safety-related components in the vicinity of the Turbine Building sump, and there have been no indications of concrete degradation due to elevated chloride levels anywhere in the plant.

   The source of the chlorides has not been determined. The Turbine Building sump is the deepest dewatering point and closest to the Intake Canal where expected underground leakage from the canal could influence the chloride level. The potential for in-plant sources of chlorides reaching the sump via secondary drains or local ground water was studied and determined to be unlikely. An Engineering evaluation concluded that, while the chloride level has remained high in the Turbine Building sump, the other sumps/piezometer well locations, some of which are located in close proximity to the Turbine Building sump, have been found to be consistently within acceptable levels. Engineering will continue to monitor the chloride levels in the Turbine Building sump on a quarterly basis. The plant procedure has been revised

to maintain sampling requirements so that trending may continue but eliminate the comparison to the acceptance criterion for this sampling point.

2. In May 2011, a spall was found on the inside concrete surface of the bioshield wall of the Unit 2 Containment 'C' steam generator cubicle. The spall was approximately six inches long by six inches wide and 1-1/4 inches deep. The reinforcing steel was not exposed. It was determined that the bioshield wall remained fully functional, but the spalled concrete required repair prior to unit startup to prevent potential degradation of the reinforcing steel. A work order was submitted and the spalled concrete has been repaired.
3. In December 2011, several embedded anchor bolts for the condenser unit of a Unit 1 Control Room chiller were found to be degraded. The anchor bolts displayed signs of corrosion and material loss. A work order was submitted and the anchor bolts were repaired in December 2011, which consisted of chipping the existing concrete around the anchor bolts until sound metal was reached, performing a weld repair of each anchor bolt, and repairing the concrete slab.
4. In October 2012, leakage (approximately one gpm) was identified in the bottom portion of the steel to concrete joint (interface between the steel elbow and the concrete pipe) of the Unit 2 'D' 96-inch circulating water line. Corrosion and coating failure on the bottom third of the pipe was observed at this location. The urethane seal around the leading (upstream) edge of the joint was also missing and degraded. A work order was submitted and the Unit 2 'D' 96-inch circulating water line joint has been repaired.
5. In January 2013, the Service Building roof was leaking, causing water to collect in two locations on the floor of the Service Building hallway. The first location was near the #1 EDG room. The second location was approximately halfway between the doors to the health physics area and the door to the operations annex. A work order was submitted and degraded roof areas were repaired.
6. In December 2014, a CR was written to document a ground water monitoring sample that showed a chloride level of 610 ppm. The sampling point that exhibited unacceptable chloride levels is located adjacent to the Intake Canal, which draws water from the river. Three months later the same sampling point was found to have chlorides at 676 ppm. These values exceeded the acceptance limit of <500 ppm. The CR evaluation determined that the elevated chloride level was probably due to unusually low rain fall on the James River, temporarily increasing its natural salinity. Results from subsequent monitoring of ground water have been acceptable, and no degradation of concrete due to elevated chloride levels has been identified.
7. In December 2015, an effectiveness review of the Civil Engineering Structural Inspection Activity (UFSAR Section 18.2.6) was performed. The aging management activity (AMA) was

evaluated against the performance criteria identified in NEI 14-12 for the Detection of Aging Effects, Corrective Actions, and Operating Experience program elements. No gaps were identified by the effectiveness review.

8. In December 2016, as part of oversight review activities, a review of procedures credited by initial license renewal AMAs was conducted to confirm the following:
   - Procedures credited for license renewal were identified
   - Procedures were consistent with the licensing basis and bases documents
   - Procedures contained a reference to conduct an aging management review prior to revising
   - Procedures credited for license renewal were identified by an appropriate program indicator and contained a reference to a license renewal document

   Procedure changes were completed as necessary to ensure the above items were satisfied.

9. In November 2017, as part of oversight review activities, the Civil Engineering Structural Inspection Activity (UFSAR Section 18.2.6) AMA owners confirmed that AMA inspections had been performed and the inspections addressed the required SSCs consistent with the aging management activity commitments required in UFSAR Chapter 18. Security lighting poles were within the scope of license renewal but were not inspected during the Civil Engineering Structural Inspection Activity cycle completed in 2012. The omission of the security lighting poles from the 2012 inspection cycle was entered in the Corrective Action Program. In December 2017, Civil Engineering inspected the light poles and noted no degradation. The License Renewal Application and supporting documentation were reviewed for in-scope structures requiring inspection, and that information was cross-referenced with the implementing procedure to confirm aging management program commitments required by UFSAR Chapter 18 were satisfied. The security lighting poles are identified in the implementing procedure as being within scope of license renewal and will be inspected during subsequent structural inspections.

10. In January 2018, an aging management program effectiveness review was conducted for the Civil Engineering Structural Inspection Activity (UFSAR Section 18.2.6), which include the *Structures Monitoring* program (B2.1.34), *Masonry Walls* program (B2.1.33) and the *Inspection of Water-Control Structures Associated with Nuclear Power Plants* program (B2.1.35). Information from the summary of that effectiveness review is provided below:

    The Civil Engineering Structural Inspection Activity is meeting or exceeding the requirements of selected NEI 14-12, "Aging Management Program Effectiveness," elements. Key activities of the AMA that were reviewed included structural inspections for aging management that have been incorporated into the periodic inspections performed for Maintenance Rule compliance. Maintenance Rule inspections, along with trending and evaluation for evidence of

aging effects, ensure the continuing capability of civil engineering structures to meet their intended functions consistent with the current licensing basis. A 10-year review of inspection results and corrective actions did not identify any aging that resulted in a loss of intended function(s).

11. In March 2018, the existing Structures Monitoring program was revised to improve the inspection techniques and to adopt new inspection techniques to manage aging effects associated with ASR degradation of concrete structures and components consistent with industry operating experience IE Notice 2011-20 (IN 2011-20), "Concrete Degradation by Alkali-Silica Reaction," and EPRI Report #3002005389 (2015), "Tools for Early Detection of ASR in Concrete Structures."

The above examples of operating experience provide objective evidence that the *Structures Monitoring* program includes activities to perform volumetric and visual inspections to identify aging effects for structures, structural supports, and structural commodities within the scope of subsequent license renewal, and to initiate corrective actions. Occurrences identified under the *Structures Monitoring* program are evaluated to ensure there is no significant impact to the safe operation of the plant and corrective actions will be taken to prevent recurrence. Guidance or corrective actions for additional inspections, re-evaluation, repairs, or replacements is provided for locations where aging effects are found. The program is informed and enhanced when necessary through the systematic and ongoing review of both plant-specific and industry operating experience. There is reasonable assurance that the continued implementation of the *Structures Monitoring* program, following enhancement, will effectively manage aging prior to a loss of intended function.

Conclusion

The continued implementation of the *Structures Monitoring* program, following enhancement, will provide reasonable assurance that aging effects will be managed such that the components within the scope of this program will continue to perform their intended functions consistent with the current licensing basis during the subsequent period of extended operation.

Table C3.3-3 SLR Expert Panel Review Results Table

Assembly	Sub-assembly	Component	Material	Screened-in Degradation Mechanisms[a]			Likelihood of Failure	Safety Consequence	Economic Consequence	Safety FMECA Group	Economic FMECA Group	Safety Consequence Risk Category	Economic Consequence Risk Category	SLR Inspection Category[b]
				MRP-191, Rev. 0	MRP-191, Rev. 1	Expert Panel [c] / MRP 2018-022								
Upper internals assembly	Control rod guide tube assemblies and flow downcomers	Bolts (Note 3)	316 SS	None	None	SCC, Fatigue	L	M	L	1	1	A	A	N
		C-tubes (Note 3)	304 SS	Wear	Wear	Wear, Fatigue	M	M	M	2	2	B	B	N
		Guide tube enclosures (Note 3)	304 SS	SCC-W, Wear	SCC-W	SCC-W, Fatigue	L	M	M	1	1	A	A	N
		Flanges - intermediate (Note 3)	304 SS	SCC-W, Fatigue	SCC-W, Fatigue	SCC-W, Fatigue	L	M	M	1	1	A	A	N
			CF8	SCC-W, Fatigue, TE	SCC-W, Fatigue, TE	SCC-W, Fatigue, TE	L	M	M	1	1	A	A	N
		Flanges - lower	304 SS	SCC-W, Fatigue	SCC-W, Fatigue	SCC-W, IASCC, Fatigue, IE	M	M	M	2	2	B	B	P
			CF8	SCC-W, Fatigue, TE, IE	SCC-W, Fatigue, TE, IE	SCC-W, IASCC, Fatigue, TE, IE	M	M	M	2	2	B	B	P
		Flexureless inserts (Unit 2 only) (Note 3)	304 SS	None	None	Fatigue	L	L	L	1	1	A	A	N
		Flexures (Unit 1 only) ~~(Note 3)~~	X-750	SCC	SCC	SCC, Fatigue	~~H~~ Note 6	~~L~~ Note 6	~~M~~ Note 6	~~3~~ Note 6	~~3~~ Note 6	~~C~~ Note 6	~~C~~ Note 6	N
		Guide plates (cards)	304 SS	SCC-W, Wear, Fatigue	SCC-W, Wear, Fatigue	SCC-W, Wear, Fatigue	H	H	M	3	3	C	C	P
			CF8	--	SCC-W, Wear, Fatigue, TE, IE	SCC-W, Wear, Fatigue, TE	H	H	M	3	3	C	C	P

Table C3.3-3 SLR Expert Panel Review Results Table

Assembly	Sub-assembly	Component	Material	Screened-in Degradation Mechanisms[a]			Likelihood of Failure	Safety Consequence	Economic Consequence	Safety FMECA Group	Economic FMECA Group	Safety Consequence Risk Category	Economic Consequence Risk Category	SLR Inspection Category[b]
				MRP-191, Rev. 0	MRP-191, Rev. 1	Expert Panel [c] / MRP 2018-022								
Upper internals assembly (cont.)	Mixing devices	Mixing devices (Note 3)	CF8	SCC-W, TE, IE	SCC-W, TE, IE	SCC-W, Fatigue, TE, IE	L	L	M	1	1	A	A	N
	Upper core plate and fuel alignment pins	Fuel alignment pins	304 SS	--	Wear	IASCC, Wear, Fatigue, IE (Note 7)	H	L	M	3	3	B	B	X
		Upper core plate	304 SS	Wear, Fatigue	Wear, Fatigue, IE	IASCC, Wear, Fatigue, IE	M	M	H	2	3	B	C	E
		Upper core plate insert (Note 3)	304 SS	--	--	Wear, IE	M	M	M	2	2	B	B	N
		Upper core plate insert bolts (Note 3)	316 SS	--	--	IASCC, Fatigue, IE, ISR/IC	L	L	M	1	1	A	A	N
		Upper core plate insert locking devices and dowel pins (Note 3)	*304L SS* (Note 2)	--	--	Fatigue, IE	L	L	M	1	1	A	A	N
		Upper core plate insert locking devices and dowel pins (Note 3)	316 SS (Note 2)	--	--	Fatigue, IE	L	L	M	1	1	A	A	N
	Upper instrumentation conduit and supports	Bolting (Note 3)	316 SS	None	None	None	--	--	--	0	0	A	A	N
			304 SS	--	None	None	--	--	--	0	0	A	A	N
		Brackets, clamps, terminal blks, conduit straps (Note 3)	304 SS	None	None	SCC, Fatigue	H	L	H	3	3	B	C	N
			CF8	--	TE	SCC, Fatigue, TE, IE	L	L	H	1	2	A	B	N
		Conduit seal assembly: body, tubesheets, tubesheet welds (Note 3)	304 SS	None	None	SCC, Fatigue	H	M	M	3	3	B	B	N

Table C3.3-3 SLR Expert Panel Review Results Table

Assembly	Sub-assembly	Component	Material	Screened-in Degradation Mechanisms[a] MRP-191, Rev. 0	MRP-191, Rev. 1	Expert Panel [c] / MRP 2018-022	Likelihood of Failure	Safety Consequence	Economic Consequence	Safety FMECA Group	Economic FMECA Group	Safety Consequence Risk Category	Economic Consequence Risk Category	SLR Inspection Category[b]
Lower internals assembly (cont.)	Core barrel	Core barrel flange (surface: upper flange weld is included below with upper core barrel girth welds)	304 SS	SCC-W, Wear	SCC-W, Wear	SCC-W, Wear, Fatigue	L	M	H	1	2	B	B	~~E~~ X
		Core barrel outlet nozzles	304 SS	SCC-W, Fatigue	SCC-W, Fatigue	SCC-W, Wear, Fatigue	L	M	H	1	2	B	B	~~E~~ N
		Lower core barrel axial welds (includes MAW and LAW) ~~Note 5~~	304 SS	SCC-W, IASCC, IE	SCC-W, IASCC, IE	SCC-W, IASCC, Fatigue, IE, VS	M	M	H	2	3	B	C	E
		Lower core barrel girth welds (~~includes~~ LGW ~~and LFW~~) Note 5	304 SS	SCC-W, IASCC, IE	SCC-W, IASCC, IE	SCC-W, IASCC, Fatigue, IE, VS	M	M	H	2	3	B	C	P
		Upper core barrel axial welds (includes UAW)	304 SS	SCC-W, IASCC, IE	SCC-W, IE	SCC-W, Fatigue	M	M	H	2	3	B	C	E
		Upper core barrel girth welds (includes UFW) Note 5	304 SS	SCC-W, IASCC, IE	SCC-W, IE	SCC-W, Fatigue	M	M	H	2	3	B	C	P
	Diffuser plate	Diffuser plate (Note 3)	304 SS	None	None	None	--	--	--	0	0	A	A	N
	Flux thimble (tubes)	Flux thimble tube plugs (Note 3)	Alloy 600	--	SCC-W, IASCC, IE, VS	SCC-W, IASCC, Fatigue, IE, VS	M	L	L	2	2	B	B	N
		Flux thimbles (tubes)	Alloy 600	--	SCC-W, IASCC, Wear, IE, VS	SCC-W, IASCC, Wear, Fatigue, IE, VS	H	L	L	3	3	B	B	X
	Head cooling spray nozzles	Head cooling spray nozzles (Note 3)	304 SS	None	None	Fatigue	L	L	L	1	1	A	A	N

Table C3.3-3 SLR Expert Panel Review Results Table

Assembly	Sub-assembly	Component	Material	Screened-in Degradation Mechanisms[a]			Likelihood of Failure	Safety Consequence	Economic Consequence	Safety FMECA Group	Economic FMECA Group	Safety Consequence Risk Category	Economic Consequence Risk Category	SLR Inspection Category[b]
				MRP-191, Rev. 0	MRP-191, Rev. 1	Expert Panel [c] / MRP 2018-022								
Lower internals assembly (cont.)	Irradiation specimen guides	Irradiation specimen access plug (dowel pin) (Note 3)	316 SS	--	--	None	--	--	--	0	0	A	A	N
		Irradiation specimen access plug (plug) (Note 3)	304 SS	IE	IE	None	--	--	--	0	0	A	A	N
		Irradiation specimen access plug (spring) (Note 3)	X-750	--	--	None	--	--	--	0	0	A	A	N
		Irradiation specimen guide (Note 3)	304 SS	Wear, IE	Wear, IE	SCC-W, Wear, Fatigue	L	L	L	1	1	A	A	N
	Lower core plate and fuel alignment pins	Fuel alignment pins	304 SS	--	IASCC, Wear, IE, VS	IASCC, Wear, IE, VS (Note 7)	H	L	M	3	3	B	B	X (added by IG)
		Lower core plate	304 SS	SCC-W, IASCC, Wear, Fatigue, IE, VS	SCC-W, IASCC, Wear, Fatigue, IE, VS	IASCC, Wear, Fatigue, IE, VS	L	M	H	1	2	A	B	X
	Lower support column assemblies	Lower support column bodies	CF8	IASCC, TE, IE, VS	IASCC, TE, IE, VS	IASCC, Fatigue, TE, IE, VS	L	L	L	1	1	A	A	E
		Lower support column bolts	316 SS	--	IASCC, Wear, Fatigue, IE, VS, ISR/IC	IASCC, Wear, Fatigue, IE, VS, ISR/IC	M	L	M	2	2	B	B	E
		Lower support column bolt locking devices (Note 3)	304L SS	--	--	IASCC, Fatigue, IE, VS	L	L	L	1	1	A	A	N
		Lower support column nuts (Note 3)	304 SS	None	None	Fatigue	L	L	L	1	1	A	A	N
		Lower support column sleeves (Note 3)	304 SS	None	None	None	--	--	--	0	0	A	A	N

a. Degradation mechanisms:
Stress corrosion cracking (SCC) [1A is applicable for SCC welds (SCC-W)]
Irradiation-assisted stress corrosion cracking (IASCC)
Wear
Fatigue (FAT)
Thermal aging embrittlement (TE)
Irradiation embrittlement (IE)
Void swelling (VS)
Thermal and irradiation-induced stress relaxation or irradiation creep (ISR/IC)

b. P = Primary, E = Expansion, X = Existing, N = No additional measures

c. Degradation mechanism added during Expert Panel review as indicated in LTR-AMLR-17-35 and LTR-AMLR-18-4.

Notes:

1. Alloy 600 was identified as the material for the support pin nuts at Surry Unit 1. These nuts were replaced as part of the control rod guide tube support pin replacement performed by AREVA. The AREVA evaluation indicates that the aging degradation mechanisms of concern are SCC and irradiation-enhanced stress relaxation/irradiation-enhanced creep (ISR/IC).
2. The upper core plate insert locking devices are 304L SS, and the dowel pins are 316 SS.
3. No additional measures.
4. The thermal shield flexure locking devices are 304L SS and the dowel pins are 304 SS.
5. MRP-227, Revision 1, added expansion links from the upper flange weld (UFW) to the lower flange weld (LFW) and to the upper girth weld (UGW).
6. For Unit 1, Babcock & Wilcox replaced the CRGT support pins and flexures with a modified design fabricated from Alloy X-750 during the CRGT replacement. The MRP-191, Revision 2, expert panel considered the Alloy X-750 flexures to be a Category C component. However, AREVA performed an evaluation of the replacement CRGT assemblies, including the replacement flexures. Section 4.1 of the AREVA report (AREVA Licensing Report ANP-3574, Rev 0, "Surry Unit 1 Modified Replacement CRGT Assembly Reconciliation with MRP-227-A for an 80-Year License", September 2017) listed those Surry Unit 1 replacement CRGT assembly components that were assigned to Categories B and C (i.e., "non-Category A") and did not include the replacement flexures in those categories. Based on this designation as a Category A component, the replacement flexures require no additional measures. Since the flexure design was modified during CRGT replacement, the B&W classification is considered appropriate for the Surry reactor internals program.
7. The fuel alignment pins screen in for multiple mechanisms because of the conservative screening criteria used and the high radiation exposure of the pin locations. However, for the fuel alignment pins in both the upper core plate and the lower core plate, degradation mechanisms other than wear are not expected to impact the function of the pins, either due to the limited amount of degradation anticipated or due to the redundancy of the pins (more than one per fuel assembly). Wear-related surface degradation that has been observed, particularly for pins with Malcomized hardening treatment, is considered the leading degradation mechanism for the fuel alignment pins.

Table C4.3-1 Primary Components

Primary Item	Effect (mechanism)	Expansion Link (Note 1)	Examination Method / Frequency (Note 1)	Examination Coverage	Source of Revision/ Addition
Control Rod Guide Tube Assembly Guide plates (cards)	Loss of material (wear)	Control rod guide tube continuous section sheaths and C-tubes (Note 18)~~None~~	Visual (VT-3) inspections and quantitative measurements are performed. Per the requirements of WCAP-17451-P, the absence of significant degradation during the inspections in 2012, confirm that no additional inspection is required prior to the normal ten-year interval[a] (Note 2).	An update provided in MRP 2018-007 indicates wear measurements to be obtained in 37 of the 48 CRGT locations.	MRP-227, Rev. 1 added WCAP-17451-P, MRP-2018-007 supplements industry WCAP-17451-P requirements.
Control Rod Guide Tube Assembly Lower flange welds, LFW	Cracking (SCC, Fatigue) Irradiation Embrittlement (IE) and Thermal Embrittlement (TE) are applicable aging mechanisms	Remaining accessible CRGT assembly lower flange welds BMI column bodies (Note 3)	Enhanced visual (EVT-1) examination to determine the presence of crack-like surface flaws in flange welds no later than 2 refueling outages from the beginning of the first license renewal period and subsequent examination on a ten-year interval.[b]	100% of outer (accessible) CRGT lower flange weld surfaces and 0.25-inch of the adjacent base metal on the individual periphery CRGT assemblies (Notes 4 and 5).	Rev. 1 added Expansion to remaining CRGT lower flange welds; Rev. 1 removed Expansion to items upper core plate and lower support forging; added 0.25 inch of base metal to examination coverage.
Core Barrel Assembly Upper flange weld; UFW	Cracking (SCC)	Upper girth weld (UGW) Lower flange weld (LFW) Upper axial weld (UAW) Lower support forging. (Note 3)	Enhanced visual (EVT-1) examination, no later than 2 refueling outages from the beginning of the first license renewal period and subsequent examination on a ten-year interval.[c]	100% of the accessible weld length of one side of the UFW and 0.75-inch of adjacent base metal shall be examined. (Notes 6 and 9).	MRP-227A initially established examination coverage. MRP-227, Rev 1, removed Expansion to core barrel outlet nozzles, and to lower support column bodies; Rev. 1 added Expansion to UGW, LFW, and UAW, and to lower support forging/casting; reduced coverage to 25%. However MRP 2018-026 increased the required examination coverage.
Core Barrel Assembly Lower girth weld; LGW (Note 8)	Cracking (SCC, IASCC, Fatigue) Irradiation Embrittlement (IE) is an applicable aging mechanism.	Middle and lower core barrel axial welds. Upper core plate. Lower support column bodies (cast). (Note 3)	Periodic enhanced visual (EVT-1) examination, no later than 2 refueling outages from the beginning of the first license renewal period and subsequent examinations on a ten-year interval.[d]	100% of the accessible weld length of the OD of the LGW and 0.75-inch of adjacent base metal shall be examined. (Note 9).	MRP 2018-022 added core barrel axial welds, upper core plate, and lower support column bodies as Expansion items. MRP 2018-026 revised the required examination coverage.

Table C4.3-1 Primary Components

Primary Item	Effect (mechanism)	Expansion Link (Note 1)	Examination Method / Frequency (Note 1)	Examination Coverage	Source of Revision/ Addition
Alignment and Interfacing Components Internals hold down spring	Distortion (Loss of load due to stress relaxation) (Note 17)	None	Direct measurement of spring height within three cycles of the beginning of (before or after) the first license renewal period. If the first set of measurements is not sufficient to assess remaining life, additional spring height measurements will be required.[j] (Note 17)	Measurements should be taken at several points around the circumference of the spring, with a statistically adequate number of measurements at each point to minimize uncertainty.	MRP-227A. A calculation of required hold down spring height for the 80-year design life confirms that the existing measured spring heights for both units are acceptable, and no further measurements are necessary
Alignment and Interfacing Components Clevis insert bolts Clevis insert dowels (Note ~~18~~19)	Cracking (SCC), Loss of material (Wear)	None	Visual (VT-3) no later than 2 refueling outages from the beginning of the first license renewal period. [k] Subsequent examinations on a ten-year interval.	All clevis insert bolts and clevis insert dowels.	Clevis insert bolts elevated to the Primary category by MRP 2018-022; the scope is expanded to include clevis insert dowels.
Alignment and Interfacing Components Thermal sleeves	Loss of material (Wear)	None	Visual inspection for top of CRGTs and/or bottom of thermal sleeve guide funnel for indications of wear per MRP 2018-010 (TB-07-02). MRP 2018-027 implements this inspection as described in NSAL 18-1.	Wear surfaces for top of CRGT and/or bottom of thermal sleeve guide funnel per MRP 2018-010 (TB-07-02).	Added as a Primary component in MRP 2018-022.
Thermal Shield Assembly Thermal shield flexures	Cracking (fatigue) or Loss of Material (wear) that results in thermal shield flexures excessive wear, fracture, or full separation	None	Visual (VT-3) no later than 2 refueling outages from the beginning of the first license renewal period. Subsequent examinations on a ten-year interval.[l]	100% of thermal shield flexures	MRP-227A
Radial Support Keys Radial support keys Stellite wear surfaces (Note ~~18~~19)	Loss of material (Wear)	None	Visual (VT-3) no later than 2 refueling outages from the beginning of the first license renewal period. Subsequent examinations on a ten-year interval.	Wear surfaces and radial support keys	Added as a Primary component in MRP 2018-022.
Alignment and Interfacing Components Clevis bearing Stellite wear surface (Note ~~18~~19)	Loss of material (Wear)	None	Visual (VT-3) no later than 2 refueling outages from the beginning of the first license renewal period. Subsequent examinations on a ten-year interval.	Wear surfaces and radial support keys	Added as a Primary component in MRP 2018-022.

j. Direct measurements of the hold down spring height were performed for Unit 1 and Unit 2 in 2012. The measurements were obtained at 8 locations around the circumference of the spring. Three measurements were performed at each location. The results indicated an acceptable spring height that confirms the capability of the hold down spring to perform its intended function for 80 years of operation.

k. The clevis insert bolting was inspected for integrity during the 2013 and 2014 outages for Unit 1 and Unit 2, respectively. VT-3 exams were performed using VT-1 acuity. The enhanced visual acuity was used specifically to address industry OE concerns of clevis insert bolt cracking. No issues were identified.

l. VT-3 examinations were performed in 2013 for the six thermal shield flexures in Unit 1. The Unit 2 inspections for the six thermal shield flexures were performed in 2014. All inspection results were satisfactory; there was no evidence of cracking (fatigue) or loss of material (wear).

Notes:

1 Examination acceptance criteria and expansion criteria for the Westinghouse components are in Table 5-3 of MRP-227-A.

2 Examination method updated in MRP-227, Revision 1 based on issuance of WCAP-17451-P for industry use. Interim Guidance issued in PWROG Letter OG-18-76 amends the requirements regarding baseline examinations.

3 The FMECA expert panel determined that Surry would follow MRP-227, Revision 1, for the expansion inspection components of the CRGT lower flange welds, which include the remaining CRGT lower flange welds and the BMI column bodies. The lower support columns (cast) and the upper core plate are added as Expansion links to the lower core barrel girth weld (Primary), and the lower core support forging would be added as an Expansion link to the upper core barrel flange weld (Primary).

4 MRP-227-A Note: A minimum of 75% of the total identified sample population must be examined.

5 Clarification in MRP-227, Revision 1, to state that 0.25 inch of the adjacent base metal must be examined for the CRGT lower flange welds.

6 MRP-227-A Note: A minimum of 75% of the total weld length (examined + unexamined), including coverage consistent with the Expansion criteria in Table 5-3, must be examined from either the inner or outer diameter for inspection credit.

7 The examination coverage for core barrel welds was redefined in MRP-227, Revision 1.

8 The upper girth weld was moved to an Expansion link from the upper flange weld in MRP-227, Revision 1.

9 MRP 2018-026 revised the examination coverage to require a minimum of 50% of the circumference of either the ID or the OD of the weld being examined

10 MRP-227-A Note: The lower core barrel flange weld may be alternatively designated as the core barrel-to-support plate weld.

11 The lower flange weld was moved to an Expansion link from the upper flange weld in MRP-227, Revision 1.

12 Bracket bolts are not applicable to the Surry design.

13 MRP-227-A Note: A minimum of 75% of the total bolt population (examine + unexamined), including coverage consistent with the Expansion criteria in Table 5-3 of MRP-227, must be examined for inspection credit.

14 Corner bolts will be added as a Primary component in the next revision of MRP-227. They will be treated the same as baffle-former bolts.

15 MRP-227-A Note: Void swelling effects on the component are managed through management of void swelling on the entire baffle-former assembly.

16 Examination timing and frequency is updated in MRP-227, Revision 1, based in issuance of MRP 2017-009 for industry use.

17 Language clarified/simplified in MRP-227, Revision 1.

18 Sheath or C-tube wear measurement can be considered best practice, but optional until the inspection when the guide card wear just above the sheaths or C-tubes has a ligament that is worn-through or is projected to wear-through before the time of the next inspection.

19 Added as a Primary component in MRP 2018-022.

Table C4.3-2 Expansion Components

Expansion Item	Effect (mechanism)	Primary Link (Note 1)	Examination Method / Frequency	Examination Coverage	Source of Revision/ Addition
Upper Internals Assembly Upper core plate	Cracking (Fatigue, wear)	Core barrel Lower Girth Weld (Note 2)	Visual (VT-3) examination. Re-inspection every 10 years following initial inspection. (Note 3)	25% of accessible surfaces. (Notes 4 and 5)	MRP-227, Revision 1. MRP 2018-022 specified VT-3 examination and 25% coverage.
Control Rod Guide Tube Assembly Remaining CRGT lower flange welds (Note 6)	Cracking (SCC, Fatigue) Irradiation Embrittlement (IE) and Thermal Embrittlement (TE) are applicable aging mechanisms.	CRGT Lower Flange Welds (Notes 2 and 6)	Enhanced visual (EVT-1) examination to determine the presence of crack-like surface flaws in flange welds. Subsequent examination on a ten-year interval.	A minimum of 75% of the CRGT assembly lower flange weld surfaces and 0.25 inch of the adjacent base metal for the flange welds not inspected under the Primary link.	MRP-227, Revision 1, added the requirement for 0.25 inch of adjacent base metal.
Control Rod Guide Tube Assembly Continuous section sheaths and C-tubes	Loss of Material (Wear)	CRGT Guide Plates (cards)	Per the requirements of WCAP-17451-P, Revision 2.	Examination coverage per the requirements of WCAP-17451-P, Revision 2	MRP-227A
Bottom Mounted Instrumentation System Bottom-mounted instrumentation (BMI) column bodies	Cracking (Fatigue) including the detection of completely fractured column bodies. Irradiation Embrittlement (IE) is an applicable aging mechanism.	CRGT Lower Flange Welds (Note 2)	Visual (VT-3) examination of BMI column bodies as indicated by difficulty of insertion / withdrawal of flux thimbles. Re-inspection every 10 years following initial inspection. Flux thimble insertion / withdrawal to be monitored at each inspection interval.	100% of BMI column bodies for which difficulty is detected during flux thimble insertion/withdrawal.	MRP-227A
Core Barrel Assembly Middle axial weld (MAW) and Lower axial weld (LAW)	Cracking (SCC, IASCC) Irradiation Embrittlement (IE) is the applicable aging mechanism.	Lower core barrel cylinder girth weld (LGW)	Enhanced visual (EVT-1) examination. Re-inspection every 10 years following initial inspection.	100% of the accessible weld length of the OD of the MAW and LAW and 0.75-inch of adjacent base metal shall be examined. (Notes 4 and ~~9~~8)	MRP 2018-026 changed the examination coverage.
Core Barrel Assembly Upper girth weld (UGW)	Cracking (SCC)	Upper core barrel flange weld (UFW).	Enhanced visual (EVT-1) examination. Re-inspection every 10 years following initial inspection.	100% of the accessible weld length of one side of the UGW and 0.75-inch of adjacent base metal shall be examined (Note ~~9~~8)	MRP-227, Revision 1, added the UGW to the Expansion category as a link from Primary-Upper flange weld (UFW). MRP 2018-026 changed the examination coverage.

Table C4.3-2 Expansion Components

Expansion Item	Effect (mechanism)	Primary Link (Note 1)	Examination Method / Frequency	Examination Coverage	Source of Revision/ Addition
Core Barrel Assembly Lower flange weld (LFW)	Cracking (SCC)	Upper core barrel flange weld (UFW).	Enhanced visual (EVT-1) examination. Re-inspection every 10 years following initial inspection.	100% of the accessible weld length of the OD surface of the LFW and 0.75-inch of adjacent base metal shall be examined. (Note ~~9~~8)	MRP-227, Revision 1, added the LFW to the Expansion category as a link from Primary-Upper flange weld (UFW). MRP 2018-026 changed the examination coverage.
Core Barrel Assembly Upper axial weld (UAW)	Cracking (SCC, IASCC) Irradiation Embrittlement (IE) is an applicable aging mechanism.	Upper core barrel flange weld (UFW).	Enhanced visual (EVT-1) examination. Re-inspection every 10 years following initial inspection.	100% of the accessible weld length of one side of the UAW and ¾' of adjacent base metal shall be examined (Note ~~9~~8)	MRP-227, Revision 1, added the UAW to the Expansion category as a link from Primary-Upper flange weld (UFW). MRP 2018-026 changed the examination coverage.
Lower Internals Assembly Lower support forging	Cracking (SCC)	Upper Core Barrel Flange Weld (UFW) (Note 2)	Visual (~~EVT-1~~VT-3) examination. Re-inspection every 10 years following initial inspection. (Note 3)	25% of the bottom surface. (Notes 4 and 5)	MRP-227, Revision 1, added this item to the Expansion category. MRP 2018-022 specified VT-3 examination and 25% coverage.
Lower Support Assembly Lower support column bodies (cast)	Cracking (IASCC) including detection of completely fractured column bodies. Irradiation Embrittlement (IE) is an applicable aging mechanism.	Lower core barrel girth Weld (Note 2)	Visual (~~EVT-1~~VT-3) examination. Re-inspection every 10 years following initial inspection. (Note 3)	25% of accessible support column assemblies as visible from above the lower core plate. (Notes 4 and 5)	MRP-227, Revision 1, added this item to the Expansion category. MRP 2018-022 specified VT-3 examination and 25% coverage.
Core Barrel Assembly Barrel-former bolts (Note 7)	Cracking (IASCC, Fatigue) Irradiation Embrittlement (IE), void swelling, irradiation-enhanced stress relaxation (ISR) aging mechanisms	Baffle-former bolts	Volumetric (UT) examination Re-inspection every 10 years following initial inspection.	100% of accessible barrel-former bolts (minimum of 75% of the total population). Accessibility may be limited by presence of thermal shield or neutron pads. (Note 4)	MRP-227A

Table C4.3-2 Expansion Components

Expansion Item	Effect (mechanism)	Primary Link (Note 1)	Examination Method / Frequency	Examination Coverage	Source of Revision/ Addition
Lower Support Assembly Lower support column bolts	Cracking (IASCC, Fatigue) Irradiation embrittlement (IE), and irradiation-enhanced stress relaxation (ISR) are applicable aging mechanisms	Baffle-former bolts	Volumetric (UT) examination Re-inspection every 10 years following initial inspection.	100% of accessible lower support column bolts (minimum of 75% of the total population), or as supported by plant-specific justification. (Note 4)	MRP-227A

Notes:

1 Examination acceptance criteria and expansion criteria for the Westinghouse components are in Table 5-3 of MRP-227-A.

2 The FMECA expert panel determined that Surry would follow MRP-227, Revision 1, for the expansion inspection components of the CRGT lower flange welds, which include the remaining CRGT lower flange welds and the BMI column bodies. The lower support columns (cast) and the upper core plate are added as Expansion links to the lower core barrel girth weld (Primary), and the lower core support forging is added as an Expansion link to the upper core barrel flange weld (Primary).

3 MRP-227-A specifies an EVT-1 examination for the upper core plate, lower support forging, and lower support columns (cast). It is noted that in MRP-227, Revision 1, the inspection technique for these components is changed to a visual (VT-3) examination.

4 MRP-227-A Note: A minimum of 75% coverage of the entire examination area or volume, or a minimum sample size of 75% of the total population of like components of the examination is required (including both the accessible and inaccessible portions).

5 The examination coverage for the upper core plate, lower support forging, and lower support column bodies was redefined in MRP-227, Revision 1.

6 Remaining CRGT lower flange welds is added as an Expansion component in MRP-227, Revision 1, but as stated in Note 2 above, Surry will inspect in accordance with MRP-227, Revision 1 for this component.

7 MRP 2018-022 was issued on the baffle-former bolt expansion components which specifies that the lower support column bolts remain the first expansion component of the BFB unless a large cluster of BFB indications is discovered during the UT exams. The presence of clustering would trigger expansion of the barrel-former bolts adjacent to the large cluster of BFB indications due to the potential for clustering to result in indications of the barrel bolts. The terms "large cluster" and "barrel-former bolts adjacent to the cluster" are defined in MRP 2018-022.

~~8 The core barrel outlet nozzle welds are eliminated as an Expansion component in MRP-227, Revision 1.~~

~~9~~8 The examination coverage for core barrel welds was redefined in MRP-227, Revision 1.