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Updated Aging Management Criteria for Electrical Portions of Subsequent License Renewal Guidance

Interim Staff Guidance

June 2020

SLR-ISG-ELECTRICAL-2020-XX

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Draft Interim Staff Guidance

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OFFICE	PM:DNLR:NLRP	PM:DNRL:NLRP	LA:DRO:ISRB	PM:DRO:IRSB
NAME	WBurton	DDrucker	BCurran	TGovan
DATE	5/5/20	5/6/20	6/16/20	5/7/20
OFFICE	QTE	STA:DNLR	BC:DNLR:NLRP	D:NRR:DEX
NAME	JDougherty	AHiser	LGibson	EBenner
DATE	5/8/20	5/12/20	5/12/20	5/27/20
OFFICE	OGC	D:NRR:DRO	D:DNRL	
NAME	STurk	THipshman for CMiller	RCaldwell for ABradford	
DATE	6/11/20	6/16/20	6/19/20	

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DRAFT INTERIM STAFF GUIDANCE

UPDATED AGING MANAGEMENT CRITERIA FOR ELECTRICAL PORTIONS OF SUBSEQUENT LICENSE RENEWAL GUIDANCE

SLR-ISG-ELECTRICAL-2020-XX

PURPOSE

The U.S. Nuclear Regulatory Commission (NRC) staff is providing this subsequent license renewal (SLR) interim staff guidance (ISG) to provide clarifying guidance to facilitate staff and industry understanding of the aging management of systems, structures, and components required in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 54, “Requirements for renewal of operating licenses for nuclear power plants.”

This draft SLR-ISG identifies proposed revisions to the electrical portions of NUREG-2191, “Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report,” issued July 2017, and NUREG-2192, “Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants,” issued July 2017 (SRP-SLR).

BACKGROUND

The NRC staff has reviewed three applications to extend plant operations to 80 years (i.e., for SLR) for Turkey Point Nuclear Generating Units 3 and 4 (Turkey Point); Peach Bottom Atomic Power Station, Units 2 and 3 (Peach Bottom); and Surry Power Station, Units 1 and 2 (Surry). During these reviews, both the staff and applicants have identified ways to make the preparation and review of future SLR applications more effective and efficient.

RATIONALE

Public meetings took place on March 28, 2019; December 12, 2019; February 20, 2020; March 25, 2020; April 3, 2020; and April 7, 2020, between the staff and industry representatives to discuss staff and industry experience in the preparation and review of the initial license renewal application for River Bend Station, Unit 1, which piloted the optimized 18-month review process for SLR applications, as well as the reviews of the first three SLR applications from Turkey Point, Peach Bottom, and Surry.

This draft SLR-ISG includes proposed revisions to the following GALL SLR Report and SRP-SLR sections:

- Aging Management Program (AMP) XI.E3A, “Electrical Insulation for Inaccessible Medium-Voltage Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements”

- AMP XI.E3B, “Electrical Insulation for Inaccessible Instrument and Control Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements”

- AMP XI.E3C, “Electrical Insulation for Inaccessible Low-Voltage Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements”

- AMP XI.E7, “High-Voltage Insulators”

APPLICABILITY

All holders of operating licenses for nuclear power reactors under 10 CFR Part 50, “Domestic licensing of production and utilization facilities,” except those that have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel.

GUIDANCE

The NRC provides requirements for the submittal and review of applications to extend plant operations beyond the initial 40-year operating period in 10 CFR Part 54.

The GALL-SLR Report and SRP-SLR provide guidance to licensees that wish to extend their plant operating licenses from 60 years to 80 years, and to the NRC staff who will review the SLR applications.

The staff and nuclear industry have identified a number of areas for which future SLR applications and staff reviews can be completed more effectively and efficiently. A series of SLR-ISGs will capture these areas, known as lessons learned.

The NRC staff considers that the information provided in this ISG provides an acceptable approach for managing aging in electrical components within the scope of 10 CFR Part 54 and will improve the quality, uniformity, effectiveness, and efficiency of NRC staff reviews of future SLR applications.

IMPLEMENTATION

The staff will use the information discussed in this draft ISG to determine whether, pursuant to 10 CFR 54.21(a)(3), a license renewal application demonstrates that the effects of aging on structures and components subject to an aging management review are adequately managed so their intended functions will be maintained consistent with the current licensing basis for the subsequent period of extended operation. This draft ISG contains an update in redline/strikeout of the guidance identified in the “Rationale” section above. An applicant may reference this ISG in an SLR application to demonstrate that the AMPs at the applicant’s facility correspond to those described in the GALL-SLR. If an applicant credits an AMP as updated by this ISG, it is incumbent on the applicant to ensure that the conditions and operating experience at the plant are bounded by the conditions and operating experience for which this draft ISG was evaluated. If these bounding conditions are not met, it is incumbent on the applicant to address any additional aging effects and augment its AMPs. For AMPs that are based on this ISG, the NRC staff will review and verify whether the applicant’s AMPs are consistent with those described in this ISG, including applicable plant conditions and operating experience.

BACKFITTING AND ISSUE FINALITY DISCUSSION

Discussion to be provided in the final ISG.

CONGRESSIONAL REVIEW ACT

Discussion to be provided in the final ISG.

FINAL RESOLUTION

By July 1, 2027, the staff will transition this information into NUREG-2191 (GALL-SLR) and NUREG-2192 (SRP-SLR). Following the transition of this guidance to NUREG-2191 and NUREG-2192, this ISG will be closed.

APPENDICES

A. Proposed Revisions to AMP XI.E3A, “Electrical Insulation for Inaccessible Medium-Voltage Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements”

B. Proposed Revisions to AMP XI.E3B, “Electrical Insulation for Inaccessible Instrument and Control Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements”

C. Proposed Revisions to AMP XI.E3C, “Electrical Insulation for Inaccessible Low-Voltage Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements”

D. Proposed Revisions to AMP XI.E7, “High-Voltage Insulators”

APPENDIX A

Proposed Revisions to AMP XI.E3A, "Electrical Insulation for Inaccessible Medium-Voltage Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements"

<u>Summary of Proposed Revisions</u>

The proposed revisions add inspection of manholes with water level monitoring and alarms that result in consistent, subsequent pump out of accumulated water prior to wetting or submergence of cable at least once every five years. Also, the proposed revisions add inspection of manholes following event-driven occurrences such as heavy rain, rapid thawing of ice and snow, or flooding, only when water level monitoring indicates water is accumulating. Based on the review of a previous SLRA, manholes with water level monitoring and alarms are self-monitoring, and therefore do not require annual inspection for water accumulation.

<u>Basis for Revisions</u>

The staff finds that there is no need to perform annual inspections for manholes that have an installed water level monitoring and alarm system if there are provisions for a timely response to level alarms. Manholes with water level monitoring and alarms, and timely pump out, prevent water accumulation from wetting or submerging cables. There is no adverse industry operating experience for the level monitoring equipment. Therefore, the staff finds that inspecting manholes with installed water level monitoring and alarms every five years is acceptable. Additionally, because of the level transmitters' continuous monitoring and alarms, there is no need for event-driven inspections if there is no water accumulation. Therefore, the staff finds acceptable a practice of inspecting manholes with water level monitoring and alarms following event-driven occurrences, only when the water level monitoring indicates water is accumulating. These water level monitoring systems are widely used in the industry, are very reliable, and can cope with a variety of operating conditions encountered in manholes at nuclear power plants. The water level monitoring system is self-monitoring. If it fails, indication will be shown in the control room. This proposed change provides continuous monitoring of water level in manholes rather than annual inspection of water level in manholes.

<u>Proposed AMP Revisions</u>

Program Description

The purpose of the aging management program (AMP) is to provide reasonable assurance that the intended functions of inaccessible medium-voltage power cables (operating voltages of 2 kV to 35 kV) that are not subject to the environmental qualification requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) 50.49 are maintained consistent with the current licensing basis through the subsequent period of extended operation. This AMP applies to all inaccessible or underground (e.g., installed in buried conduit, embedded raceway, cable trenches, cable troughs, duct banks, vaults, manholes, or direct buried installations) medium-voltage cables within the scope of subsequent license renewal (SLR) exposed to wetting or submergence (i.e., significant moisture). Inaccessible medium-voltage cables designed for continuous wetting or submergence are also included in this AMP for a one-time inspection and test.

Most electrical cables in nuclear power plants are located in dry environments. However, some cables are inaccessible or underground, located in buried conduits, cable trenches, cable troughs, duct banks, vaults, or direct buried installations that may be exposed to water intrusion due to wetting or submergence. When an inaccessible medium-voltage power cable is exposed to wet, submerged, or other environments for which it was not designed, age related degradation of the electrical insulation may occur. Electrical insulation subjected to wetting or submergence could have an adverse effect on operability, or potentially lead to failure of the cable insulation system. Although variations exist in the aging mechanisms and effects depending on cable insulation material and manufacture, periodic actions are necessary to minimize the potential for insulation degradation.

Periodic actions are taken to prevent inaccessible medium-voltage cables from being exposed to significant moisture. Significant moisture is defined as exposure to moisture that lasts more than three days (i.e., long term wetting or submergence over a continuous period) that if left unmanaged, could potentially lead to a loss of intended function. Cable wetting or submergence that results from event driven occurrences and is mitigated~~occurs for a limited time as drainage occurs~~ by either automatic or passive drains is not considered significant moisture for this AMP.

The inspection frequency for water accumulation is established and performed based on plant-specific operating experience (OE) over time with cable wetting or submergence. Inspections are performed periodically based on water accumulation over time. The periodic inspection occurs at least once annually with the first inspection for subsequent license renewal (SLR) completed prior to the subsequent period of extended operation. Inspection frequencies are adjusted based on inspection results including plant-specific OE but with a minimum inspection frequency of at least once annually. Inspections are also performed after event driven occurrences, such as heavy rain, rapid thawing of ice and snow, or flooding. Inspection of manholes equipped with water level monitoring and alarms that result in consistent and subsequent pump out of accumulated water prior to wetting or submergence of cables can be performed at least once every five years, if supported by plant operating experience. Inspections of manholes equipped with water level monitoring and alarms are also performed following event-driven occurrences if water accumulation is indicated by the monitoring system (e.g., frequent level alarm). Credit for water level monitoring equipment can be taken if such devices have continuous self-monitoring features and generate failure alarms at a central location or the control room. Reliability and methods of ensuring continuous operation of level monitoring devices are justified and documented.

Examples of periodic actions to mitigate inaccessible medium-voltage cable exposure to significant moisture include inspection for water accumulation in cable manholes and conduits and removing water, as needed. However, these actions may not be sufficient to verify that water is not trapped elsewhere in the raceways. For example, water accumulation and submergence could occur from: (a) a duct bank conduit with low points in the routing, (b) concrete cracking due to soil settling over a long period of time, (c) manhole covers not being watertight, (d) routing locations subject to a high water table (e.g., high seasonal cycles), and (e) wetting and submergence potential even when duct banks are sloped with the intention to minimize water accumulation.

Therefore, in addition to the above periodic actions, in-scope inaccessible medium-voltage power cables exposed to significant moisture are tested to determine the condition of the electrical insulation. One or more tests may be required based on cable application, construction, and electrical insulation material to determine the ~~age degradation~~age-related degradation of the cable. Cable testing as part of an existing maintenance or surveillance program, with justification, can be credited in lieu of, or in combination with, testing recommended in this AMP. A plant-specific inaccessible medium-voltage cable test matrix that documents inspection methods, test methods, and acceptance criteria for the applicant's plant-specific in-scope inaccessible medium-voltage power cables is developed based on OE.

Note: inaccessible medium-voltage cables designed for continuous wetting or submergence are also included in this AMP for a one-time inspection and test with additional periodic tests and inspections determined by the test/inspection results and industry and plant-specific OE.

The first tests for license renewal are to be completed prior to the subsequent period of extended operation with subsequent tests performed at least once every 6 years thereafter. For inaccessible medium power cables exposed to significant moisture, test frequencies are adjusted based on test results (including trending of aging degradation where applicable) and plant-specific OE but with a minimum test frequency of at least once every 6 years.

As stated in NUREG/CR–5643, "the major concern is that failures of deteriorated cable systems (cables, connections, and penetrations) might be induced during accident conditions." Because the cables are not subject to the environmental qualification requirements of 10 CFR 50.49, an AMP is required to manage the aging effects. This AMP provides reasonable assurance the insulation material for electrical cables will perform its intended function for the subsequent period of extended operation.

Evaluation and Technical Basis

1. ***Scope of Program**:* This AMP applies to inaccessible or underground medium-voltage (2kV to 35kV) power cable installations (e.g., direct buried, buried conduit, duct bank, embedded raceway, cable trench, vaults, or manholes) that are within the scope of subsequent license renewal and potentially exposed to significant moisture.

   Significant moisture is defined as exposure to moisture that lasts more than three days ~~(~~that if left unmanaged, could potentially lead to a loss of intended function. Cable wetting or submergence that results from event driven occurrences and is mitigated by either automatic or passive drains ~~occurs for a limited time as in the case of automatic or passive drainage~~ is not considered significant moisture for this AMP.

   In-scope inaccessible medium-voltage cable splices subjected to wetting or submergence are also included within the scope of this program. Submarine or other cables designed for continuous wetting or submergence are also included in this AMP as a one-time inspection and test with additional periodic tests and inspections determined by the one-time test/inspection results as well as industry and plant-specific OE.

2. ***Preventive Actions**:* This is a condition monitoring program. However, periodic actions are taken to prevent inaccessible medium-voltage power cables from being exposed to significant moisture, such as identifying and inspecting conduit ends and cable manholes/vaults for water accumulation, and removing the water, as needed.

   The inspection frequency for water accumulation is established and performed based on plant-specific OE with cable wetting or submergence. The inspections are performed periodically based on water accumulation over time. The periodic inspection occurs at least once annually with the first inspection for SLR completed prior to the subsequent period of extended operation. The annual inspection frequency is consistent with U.S. Nuclear Regulatory Commission Inspection Manual, Attachment 71111.06, "Flood Protection Measures." Inspection of manholes equipped with water level monitoring and alarms that result in consistent and subsequent pump out of accumulated water prior to wetting or submergence of cables can be performed at least once every five years, asif supported by plant operating experience. Credit for water level monitoring equipment can be taken if such devices have continuous self-monitoring features and generate failure alarms at a central location or the control room. Reliability and methods of ensuring continuous operation of level monitoring devices are justified and documented.

Inspections for water accumulation are also performed after event- -driven occurrences, such as heavy rain, rapid thawing of ice and snow, or flooding. Inspection of manholes with water level monitoring and alarms are performed following event-driven occurrences if water accumulation is indicated by the monitoring system (e.g., frequent water level alarms). Plant-specific parameters are established for the initiation of an event driven inspection. Inspections include direct indication that cables are not wetted or submerged, and that cable/splices and cable support structures are intact. Dewatering systems (e.g., sump pumps and passive drains) and associated alarms are inspected, and their operation verified periodically. The periodic inspection includes documentation that either automatic or passive drainage systems or manually pumping areis effective in preventing cable exposure to significant moisture.

If water is found during inspection, corrective actions are taken per the applicant's corrective action program to keep the cables free from significant moisture and to assess cable degradation. The aging management of the physical structures, including cable support structures of cable vaults/manholes is managed by Generic Aging Lessons Learned Subsequent License Renewal (GALL-SLR) Report AMP XI.S6, "Structures Monitoring."

3. ***Parameters Monitored or Inspected**:* Inspection for water accumulation is performed based on plant-specific OE with water accumulation over time.

Inaccessible or underground medium-voltage power cables within the scope of license renewal exposed to significant moisture are tested to determine the age degradationage-related degradation of the electrical insulation.

The reliability, self-monitoring features, and operation of continuous water level and alarm capabilities of such devices, if installed and credited for five-year inspection intervals, are demonstrated routinely depending on the attributes of the specific equipment used.

4. ***Detection of Aging Effects**:* For inaccessible medium-voltage power cables exposed to significant moisture, test frequencies are adjusted based on test results (including trending of aging degradation where applicable) and plant-specific OE. Cable testing occurs at least once every 6 years. The first tests for license renewal are to be completed prior to the subsequent period of extended operation with additional tests performed at least once every 6 years thereafter. This is an adequate period to monitor performance of the cable and take appropriate corrective actions since experience has shown that although a slow process, aging degradation could be significant.

The specific type of test performed is determined prior to the initial test. Testing of installed inservice cables is comprised of one or more tests utilizing mechanical, electrical, or chemical means that determines, with reasonable assurance, in-scope inaccessible medium-voltage electrical insulation ~~age degradation~~age-related degradation. One or more tests may be required due to cable application, construction, and electrical insulation material to determine the ~~age degradation~~age-related degradation of the cables. Cable testing as part of an existing maintenance or surveillance program, with justification, can be credited in lieu of, or in combination with, testing recommended in this AMP. A plant-specific inaccessible medium-voltage cable test matrix that documents inspection methods, test methods, and acceptance criteria for the applicant's in-scope inaccessible medium-voltage power cables is developed based on OE.

5. ***Monitoring and Trending****:* Where practical, identified degradation is projected until the next scheduled inspection. Results are evaluated against acceptance criteria to confirm that the timing of subsequent inspections will maintain the components' intended functions throughout the subsequent period of extended operation based on the projected rate of degradation. However, condition monitoring cable test and inspection results, utilizing the same visual inspection and test methods that are trendable and repeatable, provide additional information on the rate of cable or connection insulation degradation.

6. ***Acceptance Criteria****:* An unacceptable indication is defined as a noted condition or situation, which~~,~~ if left unmanaged, could potentially lead to a loss of intended function.

   The acceptance criteria for each test or inspection are determined by the specific type of test performed and the specific cable tested. Acceptance criteria for inspections for water accumulation are defined by the direct indication that cable support structures are intact, and cables are not subject to significant moisture. Dewatering systems (e.g., sump pumps and drains) and associated alarms are inspected, and their operation verified to prevent unacceptable exposure to significant moisture. Proper and reliable operation, as well as self-monitoring features of continuous water level and alarm capabilities of such devices, if installed and credited for five-year inspection intervals, are demonstrated routinely to be functional according to the requirements and attributes of the specific equipment used.

7. ***Corrective Actions****:* Results that do not meet the acceptance criteria are addressed in the applicant's corrective action program under those specific portions of the quality assurance (QA) program that are used to meet Criterion XVI, "Corrective Action," of 10 CFR Part 50, Appendix B. Appendix A of the GALL-SLR Report describes how an applicant may apply its 10 CFR Part 50, Appendix B, QA program to fulfill the corrective actions element of this AMP for both safety-related and nonsafety-related structures and components (SCs) within the scope of this program

8. ***Confirmation Process****:* The confirmation process is addressed through those specific portions of the QA program that are used to meet Criterion XVI, "Corrective Action," of 10 CFR Part 50, Appendix B. Appendix A of the GALL-SLR Report describes how an applicant may apply its 10 CFR Part 50, Appendix B, QA program to fulfill the confirmation process element of this AMP for both safety-related and nonsafety-related SCs within the scope of this program.

9. ***Administrative Controls**:* Administrative controls are addressed through the QA program that is used to meet the requirements of 10 CFR Part 50, Appendix B, associated with managing the effects of aging. Appendix A of the GALL-SLR Report describes how an applicant may apply its 10 CFR Part 50, Appendix B, QA program to fulfill the administrative controls element of this AMP for both safety-related and nonsafety-related SCs within the scope of this program.

10. ***Operating Experience**:* Operating experience has shown that medium-voltage power cable electrical insulation materials undergo increased degradation either through water tree formation or other aging mechanisms when subjected to significant moisture. Inaccessible medium-voltage cables subjected to significant moisture may result in an increased ~~age degradation~~age-related degradation of electrical insulation. Minimizing exposure to significant moisture mitigates the potential for age-related degradation.

    The program is informed and enhanced when necessary through the systematic and ongoing review of both plant-specific and industry OE including research and development such that the effectiveness of the AMP is evaluated consistent with the discussion in Appendix B of the GALL-SLR Report.

References

10 CFR Part 50, Appendix B, “Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants.” Washington, DC: U.S. Nuclear Regulatory Commission. 2016.

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____. Regulatory Guide 1.211, “Qualification of Safety-Related Cables and Field Splices for Nuclear Power Plants.” Revision 0. ADAMS Accession No. ML082530205. Washington, DC: U.S. Nuclear Regulatory Commission. April 1, 2009.

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Proposed Revisions to FSAR Supplement

None

Proposed Revisions to AMR Items

None

APPENDIX B

Proposed Revisions to AMP XI.E3B, "Electrical Insulation for Inaccessible Instrument and Control Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements"

Summary of Proposed Revisions

The proposed revisions add inspection of manholes with water level monitoring and alarms that result in consistent, subsequent pump out of accumulated water prior to wetting or submergence of cable at least once every five years. Also, the proposed revisions add inspection of manholes following event-driven occurrences such as heavy rain, rapid thawing of ice and snow, or flooding only when water level monitoring indicates water is accumulating. Based on the review of a previous SLRA, manholes with water level monitoring and alarms are self-monitoring, and therefore do not require annual inspection for water accumulation.

Basis for Revisions

The staff finds that there is no need to perform annual inspections for manholes that have an installed water level monitoring and alarm system if there are provisions for a timely response to level alarms. Manholes with water level monitoring and alarms, and timely pump out, prevent water accumulation from wetting or submerging cables. There is no adverse industry operating experience for the level monitoring equipment. Therefore, the staff finds that inspecting manholes with installed water level monitoring and alarms every five years is acceptable. Additionally, because of the level transmitters' continuous monitoring and alarms, there is no need for event-driven inspections if there is no water accumulation. Therefore, the staff finds acceptable a practice of inspecting manholes with water level monitoring and alarms following event-driven occurrences, only when the water level monitoring indicates water is accumulating. These water level monitoring systems are widely used in the industry, are very reliable and can cope with a variety of operating conditions encountered in nuclear power plant manholes. The water level monitoring system is self-monitoring. If it fails, indication will be shown in the control room. This proposed change provides continuous monitoring of water level in manholes rather than annual inspection of water level in manholes.

Proposed AMP Revisions

Program Description

The purpose of the aging management program (AMP) is to provide reasonable assurance that the intended functions of inaccessible or underground instrument and control cables that are not subject to the environmental qualification (EQ) requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) 50.49 are maintained consistent with the current licensing basis through the subsequent period of extended operation.

This AMP applies to inaccessible or underground (e.g., installed in buried conduit, embedded raceway, cable trenches, cable troughs, duct banks, vaults, manholes, or direct buried installations) instrumentation and control cables within the scope of subsequent license renewal (SLR) exposed to significant moisture. Significant moisture is defined as exposure to moisture that lasts more than three days that, if left unmanaged, could potentially lead to a loss of intended function. Cable wetting or submergence that results from event driven occurrences and is mitigated by either automatic or passive drains is not considered significant moisture for the purposes of this AMP.

When an inaccessible instrument and control cable is exposed to wet, submerged, or other environments for which it was not designed, accelerated ~~age degradation~~age-related degradation of the electrical insulation may occur. The degradation of the cable shield due to water intrusion may introduce electrical ground issues and noise into the circuit.

The risk contribution due to a failure of an inaccessible instrument and control cable may be limited due to system architecture. However, a common environmental aging stressor, such as submergence, represents an aging mechanism that if not anticipated in the design or mitigated in service, could have an adverse effect on operability, may lead to multiple random failures of the cable insulation system, and compromise system defense-in-depth.

In this AMP, periodic actions are taken to prevent inaccessible instrumentation and control cables from being exposed to significant moisture.

Examples of periodic actions include inspecting for water accumulation in cable manholes, vaults, conduits, and removing water, as needed. Instrumentation and control cables accessible from manholes, vaults, or other underground raceways are visually inspected for cable surface abnormalities. However, these periodic actions may not be sufficient due to the inability to remove accumulated water trapped in the raceways. For example, water accumulation or submergence could occur from: (a) a duct bank conduit with low points in the routing, (b) raceway settling or cracking due to soil settling over a long period of time, (c) manholes and cable trench covers not being watertight, (d) raceway locations subject to a high water table (e.g., high seasonal cycles), and (e) potential wetting or submergence even when duct banks are sloped with the intention to minimize water accumulation.

Inspection of manholes equipped with water level monitoring and alarms that result in consistent and subsequent pump out of accumulated water prior to wetting or submergence of cables can be performed at least once every five years, if supported by plant operating experience. Inspections of manholes equipped with water level monitoring and alarms are also performed following event-driven occurrences if water accumulation is indicated by the monitoring system (e.g., frequent level alarm). Credit for water level monitoring equipment can be taken if such devices have continuous self-monitoring features and generate failure alarms at a central location or the control room. Reliability and methods of ensuring continuous operation of level monitoring devices are justified and documented.

Therefore, in addition to the above periodic actions, in-scope inaccessible and underground instrumentation and control cables subject to significant moisture are evaluated to determine whether testing is required. If required, initial testing is performed once by utilizing sampling to determine the condition of the electrical insulation. One or more tests may be required due to cable type, application, and electrical insulation to determine the ~~age degradation~~age-related degradation of the cable. Inaccessible instrumentation and control cables designed for continuous wetting or submergence are also included in this AMP as a one-time inspection and test. The need for additional tests and inspections is determined by the test/inspection results as well as industry and plant-specific operating experience (OE).

Testing of installed inservice inaccessible and underground instrumentation and control cables as part of an existing maintenance, calibration or surveillance program, testing of coupons, abandoned or removed cables, or inaccessible medium- or low-voltage power cables subjected to the same or bounding environment, inservice application, cable routing, construction, manufacturing and insulation material may be credited in lieu of or in combination with testing of installed inservice inaccessible instrumentation and control cables when testing is recommended in this AMP.

As stated in NUREG/CR–5643, “the major concern is that failures of deteriorated cable systems (cables and penetrations) might be induced during accident conditions.” Because the cables are not subject to the EQ requirements of 10 CFR 50.49, an AMP is required to manage the aging effects. This AMP provides reasonable assurance that insulation material for electrical cables will perform its intended function for the subsequent period of extended operation.

Evaluation and Technical Basis

1. ***Scope of Program**:* This AMP applies to inaccessible and underground (e.g., installed in buried conduit, embedded raceway, cable trenches, cable troughs, duct banks, vaults, manholes, or direct buried installations) instrumentation and control cables that are within the scope of SLR and potentially, exposed to significant moisture.

   For this AMP, instrumentation cables are cables carrying either analog or digital signals such as coaxial cable, or cable comprised of twisted 16 or 18 American wire gauge (AWG) conductor shielded pairs rated 300V with an overall shield. Examples of control cables included in this AMP are multi-conductor 600V 12 or 14 AWG cables used to monitor or initiate control functions through indication, switches, limit switches, relays, contacts, etc.

   Significant moisture is defined as exposure to moisture that lasts more than three days that if left unmanaged, could potentially lead to a loss of intended function. Cable wetting or submergence that results from event driven occurrences and is mitigated by either automatic or passive drains is not considered significant moisture for the purposes of this AMP.

   In-scope inaccessible and underground instrumentation and control cable splices subjected to wetting or submergence are included within the scope of this program. Cables designed for continuous wetting or submergence are also included in this AMP as a one-time inspection and test where additional tests and periodic visual inspections are determined by the test/inspection results and industry and plant-specific aging degradation OE with the applicable cable electrical insulation.

2. ***Preventive Actions**:* This is a condition monitoring program. However, periodic actions are taken to prevent inaccessible and underground instrumentation and control cables from being exposed to significant moisture, such as identifying and inspecting in-scope accessible cable conduit ends and cable manholes/vaults for water accumulation, and removing the water, as needed.

   The inspection frequency for water accumulation in manholes/vaults is established and performed based on plant-specific OE with cable wetting or submergence. The inspections are performed periodically based on water accumulation over time. The periodic inspection occurs at least once annually with the first inspection for SLR completed prior to the subsequent period of extended operation. The annual inspection frequency is consistent with NRC Inspection Manual, Attachment 71111.06, “Flood Protection Measures.” Inspection of manholes equipped with water level monitoring and alarms that result in consistent and subsequent pump out of accumulated water prior to wetting or submergence of cables can be performed at least once every five years, if supported by plant operating experience. Credit for water level monitoring equipment can be taken if such devices have continuous self-monitoring features and generate failure alarms at a central location or the control room. Reliability and methods of ensuring continuous operation of level monitoring devices are justified and documented.

Inspections for water accumulation are also performed after event-driven occurrences, such as heavy rain, rapid thawing of ice and snow, or flooding. Inspections of manholes with water level monitoring and alarms are performed following event-driven occurrences if water accumulation is indicated by the monitoring system (e.g., frequent water level alarms). Plant-specific parameters are established for the initiation of an event-driven inspection. Inspections include direct indication that cables are not submerged, and that cable/splices and cable support structures are intact. Dewatering systems (e.g., sump pumps and passive drains) and associated alarms are inspected and their operation verified periodically. The periodic inspection includes documentation that either automatic or passive drainage systems, or manual pumping of manholes or vaults is effective in preventing inaccessible cable exposure to significant moisture.

The aging management of the physical structure, including cable support structures and cable vaults or manholes, is managed by Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report AMP XI.S6, "Structures Monitoring."

3. ***Parameters Monitored or Inspected**:* Inspection for water accumulation in manholes/vaults is performed periodically based on plant-specific OE with water accumulation over time.

Inaccessible and underground instrumentation and control cables within the scope of SLR are periodically visually inspected to assess ~~age degradation~~age-related degradation of the electrical insulation. Inaccessible and underground instrumentation and control cables found to be exposed to significant moisture are evaluated (e.g., a determination is made as to whether a periodic or one-time test is needed for condition monitoring of the cable insulation system). Cable installation systems that are known or subsequently found through either industry or plant-specific OE to degrade with continuous exposure to significant moisture (e.g., Vulkene and Raychem cross-linked polyethylene) are also tested to monitor cable electrical insulation degradation over time. The specific type of test(s) should be a proven technique capable of detecting reduced insulation resistance or degraded dielectric strength of the cable insulation system due to wetting or submergence.

Visual inspection of inaccessible and underground instrumentation and control cables also includes a determination as to whether other adverse environments exist. Cables subjected to these adverse environments are also evaluated for significant aging degradation of the cable insulation system.

The reliability, self-monitoring features, and operation of continuous water level and alarm capabilities of such devices, if installed and credited for five-year inspection intervals, are demonstrated routinely depending on the attributes of the specific equipment used.

4. ***Detection of Aging Effects**:* For inaccessible instrumentation and control cables exposed to significant moisture, visual inspection frequency is adjusted based on inspection and test results as well as plant-specific and industry OE. For inaccessible and underground instrumentation and control cables exposed to significant moisture where testing is required, a one-time test is performed. Visual inspection occurs at least once every 6 years and may be coordinated with the periodic inspection for water accumulation. This is an adequate period to monitor performance of instrumentation and control cables and take appropriate corrective actions since industry OE has shown that although a slow process, ~~age degradation~~age-related degradation could be significant. Required testing and the initial visual inspection for SLR are to be completed prior to the subsequent period of extended operation.

   Cables are periodically visually inspected for cable jacket surface abnormalities, such as: embrittlement, discoloration, cracking, melting, swelling, or surface contamination due to the aging mechanism and effects of significant moisture. The cable insulation visual inspection portion of the AMP uses the cable jacket material as representative of the aging effects experienced by the instrumentation and control cable electrical insulation. ~~Age degradation~~Age-related degradation of the cable jacket may indicate accelerated age degradation of the electrical insulation due to significant moisture or other aging mechanisms.

   The specific type of test(s) determines, with reasonable assurance, in-scope inaccessible instrumentation, and control cable insulation ~~age degradation~~age-related degradation. One or more tests may be required based on cable application, and electrical insulation material to determine the ~~age degradation~~age-related degradation of the cable insulation.

   Testing of installed inservice inaccessible instrumentation and control cables as part of an existing maintenance, calibration or surveillance program, testing of coupons, abandoned or removed cables, or inaccessible medium- or low-voltage power cables subjected to the same or bounding environment, inservice application, cable routing, manufacturing and insulation material may be credited in lieu of or in combination with testing of installed inservice inaccessible instrumentation and control cables when testing is required in this AMP.

   The cable testing portion of the AMP utilizes sampling. The following factors are considered in the development of the electrical insulation sample: temperature, voltage, cable type, and construction including the electrical insulation composition. A sample of 20 percent with a maximum sample of 25 constitutes a representative cable sample size. The basis for the methodology and sample used is documented. If an unacceptable condition or situation is identified in the selected sample, a determination is made as to whether the same condition or situation is applicable to other inaccessible instrumentation and control cables not tested and whether the tested sample population should be expanded. The applicant's corrective action program is used to evaluate test or visual inspection results that did not meet acceptance criteria and determine appropriate corrective action (e.g., additional visual inspections or testing).

5. ***Monitoring and Trending**:* Where practical, identified degradation is projected until the next scheduled inspection. Results are evaluated against acceptance criteria to confirm that the timing of subsequent inspections will maintain the components' intended functions throughout the subsequent period of extended operation based on the

projected rate of degradation. However, condition monitoring cable tests and inspection results that are trendable and repeatable provide additional information on the rate of cable insulation degradation.

6. ***Acceptance Criteria**:* An unacceptable indication is defined as a noted condition or situation that, if left unmanaged, could potentially lead to a loss of intended function.

   The acceptance criteria for each test or inspection are determined by the specific type of test performed and the specific cable tested. Acceptance criteria for water accumulation inspections are defined by the direct indication that cable support structures are intact and cables are not subject to significant moisture. Dewatering systems (e.g., sump pumps and drains) and associated alarms are inspected, and their operation verified. Proper and reliable operation, as well as self-monitoring features of continuous water level and alarm capabilities of such devices, if installed and credited for five-year inspection intervals, are demonstrated routinely according to the requirements and attributes of the specific equipment used.

   Visual inspection results show that instrumentation and control cable jacket material are free from unacceptable surface abnormalities that indicate excessive cable insulation aging degradation.

7. ***Corrective Actions**:* Results that do not meet the acceptance criteria are addressed in the applicant's corrective action program under those specific portions of the quality assurance (QA) program that are used to meet Criterion XVI, "Corrective Action," of 10 CFR Part 50, Appendix B. Appendix A of the GALL-SLR Report describes how an applicant may apply its 10 CFR Part 50, Appendix B, QA program to fulfill the corrective actions element of this AMP for both safety-related and nonsafety-related structures and components (SCs) within the scope of this program.

8. ***Confirmation Process**:* The confirmation process is addressed through those specific portions of the QA program that are used to meet Criterion XVI, "Corrective Action," of 10 CFR Part 50, Appendix B. Appendix A of the GALL-SLR Report describes how an applicant may apply its 10 CFR Part 50, Appendix B, QA program to fulfill the confirmation process element of this AMP for both safety-related and nonsafety-related SCs within the scope of this program.

9. ***Administrative Controls**:* Administrative controls are addressed through the QA program that is used to meet the requirements of 10 CFR Part 50, Appendix B, associated with managing the effects of aging. Appendix A of the GALL-SLR Report describes how an applicant may apply its 10 CFR Part 50, Appendix B, QA program to fulfill the administrative controls element of this AMP for both safety-related and nonsafety-related SCs within the scope of this program.

10. ***Operating Experience**:* The program is informed and enhanced when necessary through the systematic and ongoing review of both plant-specific and industry OE including research and development such that the effectiveness of the AMP is evaluated consistent with the discussion in Appendix B of the GALL-SLR Report.

References

10 CFR Part 50, Appendix B, “Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants.” Washington, DC: U.S. Nuclear Regulatory Commission. 2016.

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Proposed Revisions to FSAR Supplement

None

Proposed Revisions to AMR Items

None

APPENDIX C

Proposed Revisions to AMP XI.E3C, "Electrical Insulation for Inaccessible Low-Voltage Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements"

Summary of Proposed Revisions

The proposed revisions add inspection of manholes with water level monitoring and alarms that result in consistent, subsequent pump out of accumulated water prior to wetting or submergence of cable at least once every five years. Also, the proposed revisions add inspection of manholes following event-driven occurrences such as heavy rain, rapid thawing of ice and snow, or flooding, only when water level monitoring indicates water is accumulating. Based on the review of a previous SLRA, manholes with water level monitoring and alarms are self-monitoring, and therefore do not require annual inspection for water accumulation.

Basis for Revisions

The staff finds that there is no need to perform annual inspections for manholes that have an installed water level monitoring and alarm system if there are provisions for a timely response to level alarms. Manholes with water level monitoring and alarms, and timely pump out, prevent water accumulation from wetting or submerging cables. There is no adverse industry operating experience for the level monitoring equipment. Therefore, the staff finds that inspecting manholes with installed water level monitoring and alarms every five years is acceptable.

Additionally, because of the level transmitters' continuous monitoring and alarms, there is no need for event-driven inspections if there is no water accumulation. Therefore, the staff finds an acceptable level of inspecting manholes with water level monitoring and alarms following event-driven occurrences, only when the water level monitoring indicates water is accumulating. These water level monitoring systems are widely used in the industry, are very reliable, and can cope with a variety of operating conditions encountered in nuclear power plant manholes. The water level monitoring system is self-monitoring. If it fails, indication will be shown in the control room. This proposed change provides continuous monitoring of water level in manholes rather than annual inspection of water level in manholes.

Proposed AMP Revisions

Program Description

The purpose of the aging management program (AMP) is to provide reasonable assurance that the intended functions of inaccessible or underground low-voltage ac and dc power cables (i.e., typical operating voltage of less than 1,000 V, but no greater than 2 kilovolts (kV)) that are not subject to the environmental qualification (EQ) requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) 50.49 are maintained consistent with the current licensing basis through the subsequent period of extended operation.

This AMP applies to all inaccessible or underground (e.g., installed in buried conduit, embedded raceway, cable trenches, cable troughs, duct banks, vaults, manholes, or direct buried installations) low-voltage power cables within the scope of subsequent license renewal (SLR) exposed to significant moisture. Significant moisture is defined as exposure to moisture that lasts more than three days that if left unmanaged, could potentially lead to a loss of intended function. Cable wetting or submergence that results from event driven occurrences and is mitigated by either automatic or passive drains is not considered significant moisture for the purposes of this AMP.

When an inaccessible low-voltage power cable is exposed to wet, submerged, or other environments for which it was not designed, accelerated ~~age degradation~~age-related degradation of the electrical insulation may occur. The risk contribution due to a failure of a low-voltage power cable may be limited due to system architecture. However, a common environmental aging stressor such as submergence represents an aging mechanism that if not anticipated in the design or mitigated in service, could have an adverse effect on operability, may lead to multiple random failures of the cable insulation system, and compromise system defense-in-depth.

Periodic actions are taken to prevent inaccessible low-voltage power cables from being exposed to significant moisture. Examples of periodic actions include inspecting for water accumulation in cable manholes, vaults, conduits, and removing water, as needed. Low-voltage power cables accessible from manholes, vaults, or other underground raceways are visually inspected for cable surface abnormalities. However, these periodic actions may not be sufficient due to the inability to remove accumulated water trapped in the raceways. For example, water accumulation or submergence could occur from: (a) a duct bank conduit with low points in the routing, (b) raceway settling or cracking due to soil settling over a long period of time, (c) manholes and cable trench covers not being watertight, (d) raceway locations subject to a high water table (e.g., high seasonal cycles), and (e) potential wetting or submergence even when duct banks are sloped with the intention to minimize water accumulation.

Inspection of manholes equipped with water level monitoring and alarms that result in consistent and subsequent pump out of accumulated water prior to wetting or submergence of cables can be performed at least once every five years, if supported by plant operating experience. Inspections of manholes with water level monitoring and alarms are also performed following event-driven occurrences if water accumulation is indicated by the monitoring system (e.g., frequent water level alarms). Credit for water level monitoring equipment can be taken if such devices have continuous self-monitoring features and generate failure alarms at a central location or the control room. Reliability and methods of ensuring continuous operation of level monitoring devices are justified and documented.

In addition to the above periodic actions, in-scope inaccessible and underground low-voltage power cables subject to significant moisture are evaluated to determine whether testing is required. If required, initial testing is performed once by utilizing sampling to determine the condition of the electrical insulation. One or more tests may be required due to cable type, application, and electrical insulation to determine the ~~age degradation~~age-related degradation of the cable. Inaccessible low-voltage power cables designed for continuous wetting or submergence are also included in this AMP as a one-time inspection and test. The need for additional periodic tests and inspections is determined by the test and inspection results, as well as~~,~~ industry and plant-specific operating experience (OE).

Testing of installed inservice inaccessible and underground low-voltage power cables as part of an existing maintenance, calibration or surveillance program, testing of coupons, abandoned or removed cables, or inaccessible low-voltage power cables subjected to the same or bounding environment, inservice application, cable routing, construction, manufacturing and insulation material may be credited in lieu of or in combination with testing of installed inservice inaccessible low-voltage power cables when testing is recommended in this AMP.

As stated in NUREG/CR–5643, “the major concern is that failures of deteriorated cable systems (cables, connections, and penetrations) might be induced during accident conditions.” Because the cables are not subject to the EQ requirements of 10 CFR 50.49, an AMP is required to manage the aging effects. This AMP provides reasonable assurance that insulation material for electrical cables will perform its intended function for the subsequent period of extended operation.

Evaluation and Technical Basis

1. ***Scope of Program****:* This AMP applies to inaccessible and underground (e.g., installed in buried conduit, embedded raceway, cable trenches, cable troughs, duct banks, vaults, manholes, or direct buried installations) low-voltage power cables within the scope of SLR exposed to significant moisture. For this AMP, low-voltage ac and dc power cables are considered in-scope cables with typical operating voltage of less than 1,000 V, but no greater than 2 kV.

   Significant moisture is defined as exposure to moisture that lasts more than 3 days that if left unmanaged, could potentially lead to a loss of intended function. Cable wetting or submergence that results from event-driven occurrences and is mitigated by either automatic or passive drains is not considered significant moisture for the purposes of this AMP.

   In-scope inaccessible and underground low-voltage power cable splices subjected to wetting or submergence are included within the scope of this program. Cables designed for continuous wetting or submergence are also included in this AMP as a one-time inspection and test where additional tests and periodic visual inspections are determined by the test/inspection results and industry and plant-specific aging degradation OE with the applicable cable electrical insulation.

2. ***Preventive Actions****:* This is a condition monitoring program. However, periodic actions are taken to prevent inaccessible and underground low-voltage power cables from being exposed to significant moisture, such as identifying and inspecting in-scope accessible cable conduit ends and cable manholes/vaults for water accumulation, and removing the water, as needed.

   The inspection frequency for water accumulation in manholes/vaults is established and performed based on plant-specific OE with cable wetting or submergence. The inspections are performed periodically based on water accumulation over time. The periodic inspection occurs at least once annually with the first inspection for SLR completed prior to the subsequent period of extended operation. The annual inspection frequency is consistent with U.S. Nuclear Regulatory Commission Inspection Manual, Attachment 71111.06, “Flood Protection Measures.” Inspection of manholes equipped with water level monitoring and alarms that result in consistent and subsequent pump out of accumulated water prior to wetting or submergence of cables can be performed at least once every five years, if supported by plant operating experience. Credit for water level monitoring equipment can be taken if such devices have continuous self-monitoring features and generate failure alarms at a central location or the control room. Reliability and methods of ensuring continuous operation of level monitoring devices are justified and documented.

Inspections for water accumulation are also performed after event-driven occurrences, such as heavy rain, rapid thawing of ice and snow, or flooding. Inspections of manholes with water level monitoring and alarms are performed following event-driven occurrences if water accumulation is indicated by the monitoring system (e.g., frequent water level alarms). Plant-specific parameters are established for the initiation of an event-driven inspection. Inspections include direct indication that cables are not wetted or submerged, and that cable/splices and cable support structures are intact. Dewatering systems (e.g., sump pumps and passive drains) and associated alarms are inspected, and their operation verified periodically. The periodic inspection includes documentation that either automatic or passive drainage systems, or manually pumping of manholes or vaults is effective in preventing inaccessible cable exposure to significant moisture.

The aging management of the physical structure, including cable support structures, of cable vaults/manholes is managed by Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report AMP XI.S6, “Structures Monitoring.”

3. ***Parameters Monitored or Inspected****:* Inspection for water accumulation in manholes/vaults is performed based on plant-specific OE with water accumulation over time.

Inaccessible and underground low-voltage power cables within the scope of SLR are periodically visually inspected to assess ~~age degradation~~age-related degradation of the electrical insulation. Inaccessible and underground low-voltage power cables found to be exposed to significant moisture are evaluated (e.g., a determination is made as to whether a periodic or one-time test is needed for condition monitoring of the cable insulation system). Cable installation systems that are known or subsequently found through either industry or plant-specific OE to degrade with continuous exposure to significant moisture (e.g., Vulkene and Raychem cross-linked polyethylene) are also tested to monitor cable electrical insulation degradation over time. The specific type of test(s) should be a proven technique capable of detecting reduced insulation resistance or degraded dielectric strength of the cable insulation system due to wetting or submergence.

Visual inspection of inaccessible and underground low-voltage power cables also includes a determination as to whether other adverse environments may exist. Cables subjected to these adverse environments are also evaluated for significant aging degradation of the cable insulation system.

The reliability, self-monitoring features and operation of continuous water level and alarm capabilities of such devices, if installed and credited for five-year inspection intervals, are demonstrated routinely depending on the attributes of the specific equipment used.

4. ***Detection of Aging Effects****:* For inaccessible low-voltage power cables exposed to significant moisture, visual inspection frequency is determined based on inspection and test results as well as plant-specific and industry OE. For inaccessible and underground low-voltage power cables exposed to significant moisture where testing is required, a one-time test is performed. Visual inspection occurs at least once every 6 years and may be coordinated with the periodic inspection for water accumulation. This is an adequate period to monitor performance of low-voltage power cables and take appropriate corrective actions since industry OE has shown that although a slow

process, ~~age degradation~~age-related degradation could be significant. Required testing and the initial visual inspection for SLR are to be completed prior to the subsequent period of extended operation.

Cables are periodically visually inspected for cable jacket surface abnormalities such as: embrittlement, discoloration, cracking, melting, swelling, or surface contamination due to the aging mechanism and effects of significant moisture. The cable insulation visual inspection portion of the AMP uses the cable jacket material as representative of the aging effects experienced by the low-voltage power cable electrical insulation. ~~Age degradation~~Age-related degradation of the cable jacket may indicate accelerated ~~age degradation~~age-related degradation of the electrical insulation due to significant moisture or other aging mechanisms.

The specific type of test(s) determines, with reasonable assurance, in-scope inaccessible low-voltage power cable insulation ~~age degradation~~age-related degradation. One or more tests may be required based on cable application, and electrical insulation material to determine the ~~age degradation~~age-related degradation of the cable insulation.

Testing of installed inservice low-voltage power cables as part of an existing maintenance, calibration or surveillance program, testing of coupons, abandoned or removed cables, or inaccessible low-voltage power cables subjected to the same or bounding environment, inservice application, cable routing, manufacturing and insulation material may be credited in lieu of or in combination with testing of installed inservice inaccessible low-voltage power cables when testing is required in this AMP.

The cable testing portion of the AMP utilizes sampling. The following factors are considered in the development of the electrical insulation sample: temperature, voltage, cable type, and construction including the electrical insulation composition. A sample of 20 percent with a maximum sample of 25 constitutes a representative cable sample size. The basis for the methodology and sample used is documented. If an unacceptable condition or situation is identified in the selected sample, a determination is made as to whether the same condition or situation is applicable to other inaccessible low-voltage power cables not tested and whether the tested sample population should be expanded. The applicant's corrective action program is used to evaluate test or visual inspection results that did not meet acceptance criteria and determine appropriate corrective action (e.g., additional visual inspections or testing).

5. ***Monitoring and Trending**:* Where practical, degradation is projected until the next scheduled inspection. Results are evaluated against acceptance criteria to confirm that the sampling bases (e.g., selection, size, frequency) will maintain the components' intended functions throughout the subsequent period of extended operation based on the projected rate and extent of degradation. However, condition monitoring cable tests and visual inspection results that utilize the same visual or test methods that are trendable and repeatable provide additional information on the rate of cable insulation degradation.

6. ***Acceptance Criteria**:* An unacceptable indication is defined as a noted condition or situation that if left unmanaged, could potentially lead to a loss of intended function.

The acceptance criteria for each test or inspection are determined by the specific type of test performed and the specific cable tested. Acceptance criteria for water accumulation inspections are defined by the direct indication that cables/splices and cable support structures are intact and cables are not subject to significant moisture. Dewatering systems (e.g., sump pumps and drains) and associated alarms are inspected, and their operation verified. Proper and reliable operation, as well as self-monitoring features of continuous water level and alarm capabilities of such devices, if installed and credited for five-year inspection intervals, are demonstrated routinely according to the requirements and attributes of the specific equipment used.

Visual inspection results show that low-voltage power cable jacket material is free from unacceptable surface abnormalities that indicate excessive cable insulation aging degradation.

7. ***Corrective Actions**:* Results that do not meet the acceptance criteria are addressed in the applicant's corrective action program under those specific portions of the quality assurance (QA) program that are used to meet Criterion XVI, "Corrective Action," of 10 CFR Part 50, Appendix B. Appendix A of the GALL-SLR Report describes how an applicant may apply its 10 CFR Part 50, Appendix B, QA program to fulfill the corrective actions element of this AMP for both safety-related and nonsafety-related structures and components (SCs) within the scope of this program.

   Additional inspections are conducted if one of the inspections does not meet the acceptance criteria due to current or projected degradation (i.e., trending). The number of increased inspections is determined in accordance with the site's corrective action process; however, there are no fewer than two additional inspections for each inspection that did not meet the acceptance criteria. The additional inspections are completed within the interval (e.g., refueling outage interval, 10-year inspection interval) in which the original inspection was conducted. Additional samples are inspected for any recurring degradation to ensure corrective actions appropriately address the associated causes. At multi-unit sites, the additional inspections include inspections at all of the units with the same material, environment, and aging effect combination.

8. ***Confirmation Process**:* The confirmation process is addressed through those specific portions of the QA program that are used to meet Criterion XVI, "Corrective Action," of 10 CFR Part 50, Appendix B. Appendix A of the GALL-SLR Report describes how an applicant may apply its 10 CFR Part 50, Appendix B, QA program to fulfill the confirmation process element of this AMP for both safety-related and nonsafety-related SCs within the scope of this program.

9. ***Administrative Controls**:* Administrative controls are addressed through the QA program that is used to meet the requirements of 10 CFR Part 50, Appendix B, associated with managing the effects of aging. Appendix A of the GALL-SLR Report describes how an applicant may apply its 10 CFR Part 50, Appendix B, QA program to fulfill the administrative controls element of this AMP for both safety-related and nonsafety-related SCs within the scope of this program.

10. ***Operating Experience**:* The program is informed and enhanced when necessary through the systematic and ongoing review of both plant-specific and industry OE including research and development such that the effectiveness of the AMP is evaluated consistent with the discussion in Appendix B of the GALL-SLR Report.

References

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Proposed Revisions to FSAR Supplement

None

Proposed Revisions to AMR Items

None

APPENDIX D

Proposed Revisions to AMP XI.E7, "High-Voltage Insulators"

Summary of Proposed Revisions

The proposed revisions add polymer high-voltage (HV) insulators to the scope and program elements of GALL-SLR AMP XI.E7. The current AMP addresses porcelain insulators, however, polymer insulators have been utilized in some nuclear plant sites and should be addressed accordingly. Polymer HV insulators include different material/environment and aging effects not previously considered in GALL-SLR and GALL-SRP.

Although the term "high-voltage" is used throughout AMP XI.E7, this program includes all insulators used in power systems operating at **voltages above 4 kV** and installed on in-scope portions of switchyards, transmission lines, and power systems if the insulators, for practical purposes, have similar design, application, material, construction, and are exposed to the same environmental stressors.

Basis for Revisions

The staff added polymer HV insulators to the scope and program elements of GALL-SLR AMP XI.E7. Polymer HV insulators are being used in some nuclear plant sites and are not currently discussed in GALL-SLR. Polymer HV insulators include different material/environment and aging effects not previously considered in GALL-SLR and SRP-SLR. Adding polymer insulators to this AMP enables use of this AMP to manage aging of porcelain as well as polymer HV insulators. Polymer HV insulators are typically composed of material such as fiberglass, silicone rubber (SIR), ethylene propylene rubber (EPR), epoxy, silicone gel, sealants, ductile iron, aluminum, aluminum alloys, steel, steel alloys, malleable iron, and galvanized metals. Exposure to air-outdoor can cause degradation and aging effects that can result in reduced insulation resistance due to deposits and surface contamination, reduced insulation resistance due to polymer degradation as well as loss of material caused by wind blowing on transmission conductors, all of which may require aging management. This component material/environment combination has not previously been evaluated in GALL-SLR and is considered a site-specific condition to be evaluated by the applicant.

Polymer HV insulators have been shown to have unique failure modes with little advance indications. Surface buildup of contamination can be worse for SIR (compared to porcelain insulators) due to absorption by silicone oil, especially in late stages of service life.

Typical aging degradation and mechanisms for polymer HV insulators include (but are not limited to) the following:

- Deposits and buildup of surface contamination causing reduced insulation resistance, arcing and flashover
- Polymer degradation caused by thermal degradation of organic material, radiolysis and photolysis of UV sensitive material, oxidation, and moisture intrusion
- Stress corrosion cracking (SCC) of glass fibers due to sheath degradation
- Swelling of SIR layer due to chemical contamination
- Sheath wetting caused by chemicals absorbed by oil from SIR compound

- Brittle fracture of rods resulting from discharge activity, flashunder, and flashover
- Chalking and crazing of insulator surfaces resulting in contamination, arcing, and flashover
- Water penetration through the sheath followed by electrical failure
- Bonding failure at rod and sheathing interface
- Water ingress through end fittings causing flashunder, corrosion, and fracture of glass fibers
- Potential loss of material due to wind-driven sand particles impacting insulator surfaces

Additionally, aggressive environment due to presence of excrement from birds and rodents containing chemicals such as uric acid, phosphates, and ammonia can accelerate degradation.

Proposed AMP Revisions

Program Description

The purpose of the aging management program (AMP) is to provide reasonable assurance that the intended functions of high-voltage insulators within the scope of subsequent license renewal (SLR) are maintained consistent with the current licensing basis through the subsequent period of extended operation. The high-voltage insulator program was developed specifically to age manage high-voltage insulators susceptible to aging degradation due to local environmental conditions.

Although the term “high-voltage” is used throughout AMP XI.E7, this program includes all insulators used in power systems operating at voltages **above 4 kV** and installed on in-scope portions of switchyards, transmission lines, and power systems if the insulators, for practical purposes, have similar design, application, material, construction, and are exposed to the same environmental stressors.

The high-voltage insulators program includes visual inspections to identify degradation of high-voltage insulator sub-component parts, namely; insulation and metallic elements. Visual inspection provides reasonable assurance that the applicable aging effects are identified and high-voltage insulator ~~age degradation~~age-related degradation is managed. Insulation materials used in high-voltage insulators may degrade more rapidly than expected when installed in a harmful environment. The insulation and metallic elements of high-voltage insulators are made of porcelain, cement, malleable iron, aluminum, and galvanized steel. Significant loss of metallic material can occur due to mechanical wear caused by oscillating movement of insulators due to wind. Surface corrosion in metallic parts may appear due to contamination or where galvanized or other protective coatings are worn. With substantial airborne contamination such as salt, surface corrosion in metallic parts may become significant such that the insulator no longer will support the conductor. Various airborne contaminates such as dust, salt, fog, cooling tower plume, or industrial effluent can contaminate the insulator surface leading to reduced insulation resistance. Excessive surface contaminants or loss of material can lead to insulator flashover and failure.

The most common type of high-voltage insulators used throughout switchyards, transmission lines, and power systems are porcelain. However, polymer and toughened glass high-voltage insulators are also found in some installations and are included in this AMP.

Polymer high-voltage insulators are typically composed of material such as fiberglass, silicone rubber (SIR), ethylene propylene rubber (EPR), epoxy, silicone gel, sealants, ductile iron, aluminum, aluminum alloys, steel, steel alloys, malleable iron, and galvanized metals. Exposure to air-outdoor can cause degradation and aging effects that can result in reduced insulation resistance due to deposits and surface contamination, reduced insulation resistance due to polymer degradation as well as loss of material caused by wind blowing on transmission conductors, all of which may require aging management. Polymer high-voltage insulators have been shown to have unique failure modes with little advance indications. Surface buildup of contamination can be worse for SIR (compared to porcelain insulators) due to absorption by silicone oil, especially in late stages of service life. Typical aging degradation and mechanisms for polymer high-voltage insulators include (but not limited to) the following:

- deposits and buildup of surface contamination causing reduced insulation resistance, arcing and flashover
- polymer degradation caused by thermal degradation of organic material, radiolysis and photolysis of UltraViolet (UV) sensitive material, oxidation, and moisture intrusion
- stress corrosion cracking (SCC) of glass fibers due to sheath degradation
- swelling or peeling of SIR layer due to chemical contamination
- sheath wetting caused by chemicals absorbed by oil from SIR compound
- brittle fracture of rods resulting from discharge activity, flashunder, and flashover
- chalking and crazing of insulator surfaces resulting in contamination, arcing, and flashover
- water penetration through the sheath followed by electrical failure
- bonding failure at rod and sheathing interface causing peeling
- water ingress through end fittings causing flashunder, corrosion and fracture of glass fibers
- potential loss of material due to wind-driven sand particles impacting insulator surfaces

Additionally, aggressive environment due to presence of and excrements from birds and rodents containing chemicals such as uric acid, phosphates, and ammonia can accelerate degradation.

Toughened glass high-voltage insulators are similar to porcelain in design and construction with the chief difference being the materials used to manufacture the porcelain and glass insulating shells. Both materials (porcelain and toughened glass) are ceramics that experience the same external aging effects of reduced insulation resistance from excessive surface contamination. All high-voltage insulators rely on surface rinsing from precipitation or mechanical washing to clean contaminants from the shed surfaces. Porcelain and toughened glass insulators have been in service in the utility industry for over 60 years worldwide and are considered to be mature technologies, generally standardized, and readily interchangeable with high reliability and low cost. However, unlike porcelain, toughened glass does not experience micro cracks, micro structures and crystallographic structure or defects. Because of this, the electrical resistance and capacitance of the toughened glass insulator are defined by the chemistry of the glass and the shape and dimensions of the shell and are not drastically affected by aging or time. Also, toughened glass insulators do not experience substantial loss of material as an aging effect. Loss of material is a result of event-driven external damage from an outside agency (e.g., wind-driven sand particles impacting insulator surfaces).

The high voltage insulators within the scope of this program are to be visually inspected at a frequency, determined prior to subsequent period of extended operation, based on plant-specific operating experience (OE) with the specific type of insulator used (i.e., porcelain, polymer, toughened glass). The first inspections for the subsequent period of extended operation are to be completed prior to the subsequent period of extended operation. The high-voltage insulator program provides reasonable assurance that high-voltage insulators will perform theirits intended function during the subsequent period of extended operation.

Evaluation and Technical Basis

1. ***Scope of Program***: This AMP manages the age--related degradation effects of high-voltage insulators (operating at voltages above 4 kV) within the scope of subsequent license renewal, susceptible to wind and airborne contaminants including dust, salt, fog, cooling tower plume, industrial effluent or loss of material. Different categories of high-voltage insulators such as porcelain high-voltage insulators, polymer high-voltage insulators and toughened glass high-voltage insulators are considered and covered in this AMP.

2. ***Preventive Actions***: The high-voltage insulators AMP is a condition monitoring program that relies on visual inspections and high-voltage insulator coating and cleaning to manage high-voltage insulator aging effects. High-voltage insulator periodic visual inspections are performed to monitor the buildup of contaminants on the insulator surface. The periodic coating or cleaning of high-voltage insulators limits high-voltage insulator surface contamination.

3. ***Parameters Monitored or Inspected***: The high voltage insulators within the scope of this program are visually inspected at a frequency based on plant-specific OE with the particular type insulator. High-voltage insulator surfaces are visually inspected to detect loss of material and signs of reduced insulation resistance aging effects including cracks, foreign debris, salt, dust, cooling tower plume and industrial effluent contamination. Metallic parts of the insulator are visually inspected to detect loss of material due to mechanical wear, wind-driven particle impact, or corrosion.

4. ***Detection of Aging Effects***: Visual inspection is used to detect the following two aging degradations:- (a) loss of material in the metallic parts due to corrosions and/or frequent movement, and insulation surfaces that might be subject to wind driven dust particles impacting surfaces. (b) reduced insulation resistance. The loss of material in the metallic parts is due to corrosion caused by contaminants, where galvanized or other protective coatings are worn, and mechanical wear due to wind-induced movement. Reduced insulation resistance can be caused by the presence of insulator surface contamination or weakening of sheathing due to variety of stressors including wind-driven sand particle impact. Visual inspections may be supplemented with infrared thermography inspections to detect high-voltage insulator reduced insulation resistance.

Corona cameras may also be employed to detect early signs of corona emissions. The first inspection for SLR is to be completed prior to the subsequent period of extended operation.

5. ***Monitoring and Trending***: Trending actions are not included as part of this AMP, because the ability to trend visual inspection results is limited. However, inspection results that are trendable provide additional information on the rate of insulator degradation including optimization of inspection frequencies.

6. ***Acceptance Criteria***: An unacceptable indication is defined as a noted condition or situation that, if left unmanaged, could potentially lead to a loss of intended function.

   High-voltage insulator surfaces are free from unacceptable accumulation of foreign material such as significant salt or dust buildup as well as other contaminants. Metallic parts must be free from significant loss of materials due to pitting, fatigue, crevice, ~~and~~ general corrosion, and peeling of silicone rubber sleeves (for polymer high-voltage insulators only). Acceptance criteria will be based on temperature rise above a reference temperature for the application when thermography is used. The reference temperature will be ambient temperature, or a baseline temperature based on data from the same type of high-voltage insulator being inspected.

7. ***Corrective Actions***: Results that do not meet the acceptance criteria are addressed in the applicant's corrective action program under those specific portions of the quality assurance (QA) program that are used to meet Criterion XVI, "Corrective Action," of 10 CFR Part 50, Appendix B. Appendix A of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report describes how an applicant may apply its 10 CFR Part 50, Appendix B, QA program to fulfill the corrective actions element of this AMP for both safety-related and nonsafety-related structures and components (SCs) within the scope of this program.

   Corrective actions are taken, and an engineering evaluation is performed when the acceptance criteria are not met. Corrective actions will be based on the observed degradation. The evaluation will consider the significance of the inspection results, the extent of the concern, the potential root causes, and the corrective actions required. If an unacceptable condition is identified, a determination is made as to whether the same condition or situation is applicable to other high-voltage insulators. Corrective actions will be implemented when inspection results do not meet the acceptance criteria.

8. ***Confirmation Process***: The confirmation process is addressed through those specific portions of the QA program that are used to meet Criterion XVI, "Corrective Action," of 10 CFR Part 50, Appendix B. Appendix A of the GALL-SLR Report describes how an applicant may apply its 10 CFR Part 50, Appendix B, QA program to fulfill the confirmation process element of this AMP for both safety-related and nonsafety-related SCs within the scope of this program.

9. ***Administrative Controls***: Administrative controls are addressed through the QA program that is used to meet the requirements of 10 CFR Part 50, Appendix B, associated with managing the effects of aging. Appendix A of the GALL-SLR Report describes how an applicant may apply its 10 CFR Part 50, Appendix B, QA program to fulfill the administrative controls element of this AMP for both safety-related and nonsafety-related SCs within the scope of this program.

10. ***Operating Experience***: The program is informed and enhanced when necessary through the systematic and ongoing review of both plant-specific and industry OE including research and development such that the effectiveness of the AMP is evaluated consistent with the discussion in Appendix B of the GALL-SLR Report.

References

10 CFR Part 50, Appendix B, “Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants.” Washington, DC: U.S. Nuclear Regulatory Commission. 2016.

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NRC. NUREG/CR–5643, “Insights Gained From Aging Research.” Agencywide Documents Access and Management System (ADAMS) Accession No. ML041530264. Washington, DC: U.S. Nuclear Regulatory Commission. March 31, 1992.

____. Information Notice 93-95: “Storm-Related Loss of Offsite Power Events Due to Salt Buildup on Switchyard Insulators.” ADAMS Accession No. ML031070158. Washington, DC: U.S. Nuclear Regulatory Commission. December 13, 1993.

Proposed Revisions to FSAR Supplement (Table XI-01 is reproduced in its entirety. The only change to this table occurs in AMP XI.E7.)

Table XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management Programs

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*
XI.E1	Electrical Insulation for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements	The program applies to accessible electrical cable and connection electrical insulation material within the scope of license renewal subjected to an adverse localized environment. Accessible in-scope electrical cable and connection electrical insulation material is visually inspected and tested for cable and connection insulation surface anomalies indicating signs of reduced electrical insulation resistance. If visual inspections identify degraded or damaged conditions, then testing is performed for evaluation. Visual Inspection and testing may include thermography and one or more proven condition monitoring test methods applicable to the cable and connection insulation material. Electrical cable and connection insulation material test results are to be within the acceptance criteria, as identified in the applicant's procedures.	Program and SLR enhancements, when applicable, are implemented 6 months prior to the subsequent period of extended operation.
XI.E2	Electrical Insulation for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits	The program applies to electrical cables and connections (cable system) electrical insulation material used in circuits with sensitive, high-voltage, low-level current signals within the scope of subsequent license renewal. Examples of these circuits include radiation monitoring and nuclear instrumentation that are subject to aging management review and subjected to adverse localized environments caused by temperature, radiation, or moisture. The program evaluates electrical insulation material for cables and connections subjected to an adverse localized environment at least once every 10 years.	Program and SLR enhancements, when applicable, are implemented 6 months prior to the subsequent period of extended operation.

Table XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management Programs

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*
XI.E3A	Electrical Insulation for Inaccessible Medium-Voltage Power Cables Not Subject To 10 CFR 50.49 Environmental Qualification Requirements	The program applies to inaccessible or underground (e.g., installed in buried conduits, cable trenches, cable troughs, duct banks, underground vaults, or direct buried installations) medium-voltage power cable (operating voltage; 2 kV to 35 kV) within the scope of license renewal exposed to significant moisture. This is a condition monitoring program. However, periodic actions are performed to prevent inaccessible cable from being exposed to significant moisture such as identifying and inspecting in-scope accessible cable conduit ends and cable manholes/vaults for water accumulation, and draining the water, as needed. Significant moisture is defined as exposure to moisture that lasts more than 3 days (i.e., long term wetting or submergence over a continuous period) that if left unmanaged, could potentially lead to a loss of intended function. Submarine or other cables designed for continuous wetting or submergence are also included in this AMP as a one-time inspection and test with additional periodic tests and inspections determined by one-time inspection results and industry and plant specific operating experience.	Program and SLR enhancements, when applicable, are implemented 6 months prior to the subsequent period of extended operation.
XI.E3B	Electrical Insulation for Inaccessible Instrument and Control Cables Not Subject To 10 CFR 50.49 Environmental Qualification Requirements	The program applies to inaccessible or underground (e.g., installed in buried conduits, cable trenches, cable troughs, duct banks, underground vaults, or direct buried installations) instrument and control cable, within the scope of license renewal exposed to significant moisture. This is a condition monitoring program. However, periodic actions are taken to prevent inaccessible instrumentation and control cable from being exposed to significant moisture, such as identifying and inspecting in-scope accessible cable conduit ends and cable manholes/vaults for water accumulation, and draining the water, as needed. Significant moisture is defined as exposure to moisture that lasts more than three days (i.e., long term wetting or submergence over a continuous period) that if left unmanaged, could potentially lead to a loss of intended function.	Program and SLR enhancements, when applicable, are implemented 6 months prior to the subsequent period of extended operation.

Table XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management Programs

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*
XI.E3C	Electrical Insulation for Inaccessible Low-Voltage Power Cables Not Subject To 10 CFR 50.49 Environmental Qualification Requirements	The program applies to inaccessible or underground (e.g., installed in buried conduits, cable trenches, cable troughs, duct banks, underground vaults, or direct buried installations) low-voltage power cable (operating voltage less than 2 kV) within the scope of license renewal exposed to significant moisture. This is a condition monitoring program. However, periodic actions are taken to prevent inaccessible low-voltage power cable from being exposed to significant moisture, such as identifying and inspecting in-scope accessible cable conduit ends and cable manholes/vaults for water accumulation, and draining the water, as needed. Significant moisture is defined as exposure to moisture that lasts more than 3 days (i.e., long term wetting or submergence over a continuous period) that if left unmanaged, could potentially lead to a loss of intended function.	Program and SLR enhancements, when applicable, are implemented 6 months prior to the subsequent period of extended operation.
XI.E4	Metal Enclosed Bus	The program applies to metal enclosed bus (MEB) within the scope of subsequent license renewal. The program is a condition monitoring program that utilizes sampling. The program requires the visual inspection of MEB internal surfaces to detect age-related degradation, including cracks, corrosion, foreign debris, excessive dust buildup, and evidence of moisture intrusion. MEB insulating material is visually inspected for signs of embrittlement, cracking, chipping, melting, swelling, discoloration, or surface contamination, which may indicate overheating or aging degradation. The internal bus insulating supports are visually inspected for structural integrity and signs of cracks. MEB external surfaces are visually inspected for loss of material due to general, pitting, and crevice corrosion. Accessible elastomers (e.g., gaskets, bolts, and sealants) are inspected for degradation, including surface cracking, crazing, scuffing, and changes in dimensions (e.g., ballooning and necking), shrinkage, discoloration, hardening, and loss of strength. A sample of accessible bolted connections is inspected for increased resistance of connection by using thermography or by measuring connection resistance using a micro-ohmmeter. These inspections are performed at least once every 10 years.	Program and SLR enhancements, when applicable, are implemented 6 months prior to the subsequent period of extended operation.

Table XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management Programs			
AMP	**GALL-SLR Program**	**Description of Program**	**Implementation Schedule***
XI.E5	Fuse Holders	The program applies to fuse holders outside of active equipment within the scope of subsequent license renewal and require age management activities. This is a condition monitoring program. The program utilizes visual inspection and testing to identify age-related degradation for both fuse holder electrical insulation material and fuse holder metallic clamps. The specific type of test performed is determined prior to the initial test and is to be a proven test for detecting increased resistance of connection of fuse holder metallic clamps, or other appropriate testing justified in the applicant's aging management program.	Program and SLR enhancements, when applicable, are implemented 6 months prior to the subsequent period of extended operation.
XI.E6	Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements	The program applies to electrical connections within the scope of subsequent license renewal. The program is a condition monitoring program that consists of a representative sample of electrical connections tested prior to the subsequent period of extended operation, and the results are evaluated to determine the need for subsequent testing on a 10 year basis. The following factors are considered for sampling: voltage level (medium and low-voltage), circuit loading (high loading), connection type, and location (high temperature, high humidity, vibration, etc.). Twenty percent of a connector type population with a maximum sample of 25 constitutes a representative connector sample size. Otherwise a technical justification of the methodology and sample size used for selecting components under test should be included as part of the applicant's AMP documentation. The specific type of test to be performed is a proven test for detecting increased resistance of connection. As an alternative to thermography or resistance measurement of cable connections for the accessible cable connections that are covered with electrical insulation materials such as tape, the applicant may perform visual inspection of the electrical insulation material to detect aging effects for covered cable connections. The basis for performing only a periodic visual inspection is documented.	Program and SLR enhancements, when applicable, are implemented 6 months prior to the subsequent period of extended operation.

Table XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management Programs

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*
XI.E7	High-Voltage Insulators New AMP	The program was developed specifically to address aging management of in-scope high-voltage -insulator (used on systems with operating voltages above 4 kV for the purpose of this AMP) aging mechanisms and effects. This is a condition monitoring program and manages the age--related degradation effects of loss of material and reduced insulation resistance for within in-scope high-voltage insulators susceptible to airborne contaminantes including dust, salt, fog, cooling tower plume, or industrial effluent or loss of material. This AMP is applicable to different types of high-voltage insulators such as porcelain, toughened glass, and polymer.	Program is implemented 6 months prior to the subsequent period of extended operation. Inspections 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.
XI.M1	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD	The program consists of periodic volumetric, surface, and/or visual examination of ASME Class 1, 2, and 3 pressure-retaining components, including welds, pump casings, valve bodies, integral attachments, and pressure-retaining bolting for assessment, signs of degradation, and corrective actions. This program is in accordance with the ASME Code Section XI edition and addenda approved in accordance with provisions of 10 CFR 50.55a during the subsequent period of extended operation.	Program and SLR enhancements, when applicable, are implemented 6 months prior to the subsequent period of extended operation.

Table XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management Programs			
AMP	**GALL-SLR Program**	**Description of Program**	**Implementation Schedule***
XI.M2	Water Chemistry	This program mitigates aging effects of loss of material due to corrosion, cracking due to SCC, and related mechanisms, and reduction of heat transfer due to fouling in components exposed to a treated water environment. Chemistry programs are used to control water chemistry for impurities (e.g., chloride, fluoride, and sulfate) that accelerate corrosion. This program relies on monitoring and control of water chemistry to keep peak levels of various contaminants below the system-specific limits, based on EPRI guidelines (a) BWRVIP-190 (EPRI 1016579, BWR Water Chemistry Guidelines – 2008 Revision) for BWRs or (b) EPRI 1014986 (PWR Primary Water Chemistry – Revision 7) and EPRI 1016555 (PWR Secondary Water Chemistry – Revision 7) for PWRs.	Program is implemented 6 months prior to the subsequent period of extended operation
XI.M3	Reactor Head Closure Stud Bolting	The program includes (a) ISI in conformance with the requirements of the ASME Code, Section XI, Subsection IWB, Table IWB-2500-1, and (b) preventive measures to mitigate cracking. The program also relies on recommendations to address reactor head stud bolting degradation as delineated in NRC RG 1.65, Revision 1.	Program is implemented 6 months prior to the subsequent period of extended operation

Table XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management Programs			
AMP	**GALL-SLR Program**	**Description of Program**	**Implementation Schedule***
XI.M4	BWR Vessel ID Attachment Welds	The program is a condition monitoring program that manages cracking in the reactor vessel inside diameter attachment welds. This program relies on visual examinations to detect cracking. The examination scope, frequencies, and methods are in accordance with ASME Code, Section XI, Table-IWB-2500-1, Examination Category B-N-2, and BWRVIP-48-A, "Vessel ID Attachment Weld Inspection and Flaw Evaluation Guidelines," dated November 2004. The scope of the examinations is expanded when flaws are detected. Any indications are evaluated in accordance with ASME Code, Section XI, or the guidance in BWRVIP 48-A. Crack growth evaluations follow the guidance in BWRVIP-14-A, "Evaluation of Crack Growth in BWR Stainless Steel RPV Internals, dated September 2008; BWRVIP-59-A, "Evaluation of Crack Growth in BWR Nickel-Base Austenitic Alloys in RPV Internals," dated May 2007; or BWRVIP-60-A, "BWR Vessel and Internals Project, Evaluation of Crack Growth in BWR Low Alloy Steel RPV Internals," dated June 2003; as appropriate. The acceptance criteria are in BWRVIP-48-A and ASME Code, Section XI, Subarticle IWB-3520. Repair and replacement activities are conducted in accordance with BWRVIP-52-A, "Shroud Support and Vessel Bracket Repair Design Criteria," dated September 2005.	Program is implemented 6 months prior to the subsequent period of extended operation

Table XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management Programs

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*
XI.M7	BWR Stress Corrosion Cracking	The program manages cracking due to IGSCC for all BWR piping and piping welds made of austenitic stainless steel and nickel alloy that are 4 inches or larger in nominal diameter containing reactor coolant at a temperature above 93 °C (200 °F) during power operation, regardless of code classification. The program performs volumetric examinations to detect and manage IGSCC in accordance with NRC GL 88-01. Modifications to the extent and schedule of inspection in GL 88-01 are allowed in accordance with the inspection guidance in staff-approved BWRVIP-75-A. This program relies on the staff-approved positions that are described in NUREG–0313, Revision 2, and GL 88-01 and its Supplement 1 regarding selection of IGSCC-resistant materials, solution heat treatment and stress improvement processes, water chemistry, weld overlay reinforcement, partial replacement, clamping devices, crack characterization and repair criteria, inspection methods and personnel, inspection schedules, sample expansion, leakage detection, and reporting requirements.	Program is implemented 6 months prior to the subsequent period of extended operation
XI.M8	BWR Penetrations	The program includes BWR instrumentation penetrations, CRD housing and ICMH penetrations, and standby liquid control nozzles/Core ΔP nozzles. The program manages cracking due to cyclic loading or stress corrosion cracking by performing inspection and flaw evaluation in accordance with the guidelines of staff-approved BWRVIP-49-A, BWRVIP-47-A and BWRVIP-27-A and the requirements in the ASME Code, Section XI. The examination categories include volumetric examination methods (ultrasonic testing or radiography testing), surface examination methods (liquid penetrant testing or magnetic particle testing), and visual examination methods.	Program is implemented 6 months prior to the subsequent period of extended operation

Table XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management Programs			
AMP	**GALL-SLR Program**	**Description of Program**	**Implementation Schedule***
XI.M9	BWR Vessel Internals	The program includes inspections and flaw evaluations in conformance with the guidelines of applicable staff-approved BWRVIP documents, and provides reasonable assurance of the long-term integrity and safe operation of BWR vessel internal components that are fabricated of nickel alloy and stainless steel (including martensitic stainless steel, cast stainless steel and associated welds). The program manages the effects of cracking due to SCC, IGSCC, or IASCC, cracking due to cyclic loading (including flow-induced vibration), loss of material due to wear, loss of fracture toughness due to neutron or thermal embrittlement, and loss of preload due to thermal or irradiation-enhanced stress relaxation. The program performs inspections for cracking and loss of material in accordance with the guidelines of applicable staff-approved BWRVIP documents and the requirements of ASME Code, Section XI, Table IWB 2500-1. The impact of loss of fracture toughness on component integrity is indirectly managed by using visual or volumetric examination techniques to monitor for cracking in the components. This program also manages loss of preload for core plate rim holddown bolts and jet pump assembly holddown beam bolts by performing visual inspections or stress analyses for adequate structural integrity. This program performs evaluations to determine whether supplemental inspections in addition to the existing BWRVIP examination guidelines are necessary to adequately manage loss of fracture toughness due to thermal or neutron embrittlement and cracking due to IASCC for the subsequent period of extended operation. If the evaluations determine that supplemental inspections are necessary for certain components based on neutron fluence, cracking susceptibility and fracture toughness, the program conducts the supplemental inspections for adequate aging management.	Program is implemented 6 months prior to the subsequent period of extended operation

Table XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management Programs

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*
XI.M10	Boric Acid Corrosion	This program relies, in part, on the response to NRC GL 88-05, "Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants," to identify, evaluate, and correct borated water leaks that could cause corrosion damage to reactor coolant pressure boundary components. The program also includes inspections, evaluations, and corrective actions for all components subject to aging management review that may be adversely affected by some form of borated water leakage. This program includes provisions to initiate evaluations and assessments when leakage is discovered by activities not associated with the program. This program follows the guidance described in Section 7 of WCAP-15988-NP, Revision 2, "Generic Guidance for an Effective Boric Inspection Program for Pressurized Water Reactors."	Program is implemented 6 months prior to the subsequent period of extended operation
XI.M11B	Cracking of Nickel-Alloy Components and Loss of Material due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components (PWRs Only)	This program addresses operating experience of degradation due to PWSCC of components or welds constructed from certain nickel alloys (e.g., Alloy 600/82/182) and exposed to pressurized water reactor primary coolant at elevated temperature. The scope of this program includes the following groups of components and materials: (a) all nickel alloy components and welds which are identified in EPRI MRP-126; (b) nickel alloy components and welds identified in ASME Code Cases N-770, N-729, and N-722, as incorporated by reference in 10 CFR 50.55a; and (c) components that are susceptible to corrosion by boric acid and may be impacted by leakage of boric acid from nearby or adjacent nickel alloy components previously described. This program is used in conjunction with GALL-SLR Report AMP XI.M2, "Water Chemistry" because water chemistry can affect the cracking of nickel alloys. The completeness of the plant's EPRI MRP-126 program is also verified prior to entering the subsequent period of extended operation. For nickel alloy components and welds addressed by the regulatory requirements of 10 CFR 50.55a, inspections are conducted in accordance with 10 CFR 50.55a. Other nickel alloy components and welds within the scope of this program are inspected in accordance with EPRI MRP-126.	Program is implemented 6 months prior to the subsequent period of extended operation

Table XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management Programs			
AMP	**GALL-SLR Program**	**Description of Program**	**Implementation Schedule***
XI.M12	Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)	The program consists of the determination of the susceptibility potential significance of loss of fracture toughness due to thermal aging embrittlement of CASS piping and piping components in both the BWR and PWR reactor coolant pressure boundaries ECCS systems, including interfacing pipe lines to the chemical and volume control system and to the spent fuel pool; and in BWR ECCS systems, including interfacing pipe lines to the suppression chamber and to the drywell and suppression chamber spray system in regard to thermal aging embrittlement based on the casting method, molybdenum content, and ferrite percentage. For potentially susceptible piping and piping components aging management is accomplished either through enhanced volumetric examination, enhanced visual examination, or a component-specific flaw tolerance evaluation.	Program is implemented 6 months prior to the subsequent period of extended operation
XI.M16A	PWR Vessel Internals	The program relies on implementation of the inspection and evaluation guidelines in EPRI Technical Report No. 1022863 (MRP-227-A) and EPRI Technical Report No. 1016609 (MRP-228) to manage the aging effects on the reactor vessel internal components, as supplemented by a gap analysis. This program is used to manage: (a) cracking, including stress corrosion cracking, primary water stress corrosion cracking, irradiation-assisted stress corrosion cracking, and cracking due to fatigue/cyclical loading; (b) loss of material induced by wear; (c) loss of fracture toughness due to either thermal aging, neutron irradiation embrittlement, or void swelling; (d) dimensional changes due to void swelling or distortion; and (e) loss of preload due to thermal and irradiation enhanced stress relaxation or creep. [The applicant is to provide additional details to describe the gap analysis associated with the AMP.]	Program, accounting for the impacts of a gap analysis, is implemented 6 months prior to the subsequent period of extended operation, or alternatively, a plant-specific program may be implemented 6 months prior to the subsequent period of extended operation.

Table XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management Programs			
AMP	**GALL-SLR Program**	**Description of Program**	**Implementation Schedule***
XI.M17	Flow-Accelerated Corrosion (FAC)	The program is based on the response to NRC GL 89-08, "Erosion/Corrosion-Induced Pipe Wall Thinning," and relies on implementation of the EPRI guidelines in the Nuclear Safety Analysis Center 202L [(as applicable) Revision 2, 3, or 4], "Recommendations for an Effective Flow Accelerated Corrosion Program." The program includes the use of predictive analytical software [(as applicable) CHECWORKS™, BRT CICERO™, COMSY]. [(If applicable) This program also manages wall thinning caused by mechanisms other than FAC, in situations where periodic monitoring is used in lieu of eliminating the cause of various erosion mechanisms.] This program includes: (a) identifying all susceptible piping systems and components; (b) developing FAC predictive models to reflect component geometries, materials, and operating parameters; (c) performing analyses of FAC models and, with consideration of operating experience, selecting a sample of components for inspections; (d) inspecting components; (e) evaluating inspection data to determine the need for inspection sample expansion, repairs, or replacements, and to schedule future inspections; and (f) incorporating inspection data to refine FAC models.	Program and SLR enhancements, when applicable, are implemented 6 months prior to the subsequent period of extended operation.

Table XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management Programs			
AMP	**GALL-SLR Program**	**Description of Program**	**Implementation Schedule***
XI.M18	Bolting Integrity	This program focuses on closure bolting for pressure-retaining components and relies on recommendations for a comprehensive bolting integrity program, as delineated in NUREG–1339 and EPRI NP–5769, with the exceptions noted in NUREG–1339 for safety-related bolting. The program also relies on industry recommendations for comprehensive bolting maintenance, as delineated in the EPRI 1015336 and 1015337. The program includes periodic visual inspection of closure bolting for indications of loss of preload, cracking, and loss of material due to general, pitting, and crevice corrosion, MIC, and wear as evidenced by leakage. Closure bolting that is submerged or where the piping systems contains air or gas for which leakage is difficult to detect are inspected or tested by alternative means. The program also includes sampling-based volumetric examinations of high-strength closure bolting to detect indications of cracking. The program also includes preventive measures to preclude or minimize loss of preload and cracking. A related aging management program (AMP) XI.M1, "ASME Section XI Inservice Inspection (ISI) Subsections IWB, IWC, and IWD," includes inspections of safety-related and nonsafety-related closure bolting and supplements this bolting integrity program. Other related programs, AMPs XI.S1, "ASME Section XI, Subsection IWE"; XI.S3, "ASME Section XI Subsection IWF"; XI.S6, "Structures Monitoring"; XI.S7, "Inspection of Water-Control Structures Associated with Nuclear Power Plant"; and XI.M23, "Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems," manage the inspection of safety related and nonsafety related structural bolting.	Program and SLR enhancements, when applicable, are implemented 6 months prior to the subsequent period of extended operation.

Table XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management Programs			
AMP	**GALL-SLR Program**	**Description of Program**	**Implementation Schedule***
XI.M19	Steam Generators	This program manages the aging of steam generator tubes, plugs, sleeves, divider plate assemblies (as applicable), tube-to-tubesheet welds, heads (interior surfaces of channel or lower/upper heads), tubesheets (primary side), and secondary side components that are contained within the steam generator. This program consists of aging management activities for the steam generator tubes, plugs, sleeves, and secondary side components that are contained within the steam generator in accordance with the plant technical specifications and includes commitments to NEI 97-06, Revision 3 and the associated EPRI guidelines. This program also performs general visual inspections of the steam generator heads (internal surfaces) looking for evidence of cracking or loss of material (e.g., rust stains) at least every 72 effective full power months or every third refueling outage, whichever results in more frequent inspections. The program includes foreign material exclusion as a means to inhibit wear degradation, and secondary side maintenance activities, such as sludge lancing, for removing deposits that may contribute to component degradation. The program performs volumetric examination on steam generator tubes in accordance with the requirements in the technical specifications to detect aging effects, if they should occur. The technical specifications require condition monitoring (explicitly) and operational assessments (implicitly) to be performed to ensure that the tube integrity will be maintained until the next inspection.	Program and SLR enhancements, when applicable, are implemented 6 months prior to the subsequent period of extended operation.
XI.M20	Open-Cycle Cooling Water System	The program relies, in part, on implementing the response to NRC GL 89-13, "Service Water System Problems Affecting Safety-Related Equipment," [(if applicable) and includes nonsafety-related portions of the open-cycle cooling water system]. The program includes: (a) surveillance and control to significantly reduce the incidence of flow blockage problems as a result of biofouling, (b) tests to verify heat transfer of heat exchangers, (c) routine inspection and maintenance so that corrosion, erosion, protective coating failure, fouling, and biofouling cannot degrade the performance of systems serviced by the open-cycle cooling water system. This program includes enhancements to the guidance in NRC GL 89-13 that address operating experience such that aging effects are adequately managed.	Program and SLR enhancements, when applicable, are implemented 6 months prior to the subsequent period of extended operation.

Table XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management Programs			
AMP	**GALL-SLR Program**	**Description of Program**	**Implementation Schedule***
XI.M21A	Closed Treated Water Systems	This is a mitigation program that also includes a condition monitoring program to verify the effectiveness of the mitigation activities. The program consists of: (a) water treatment, including the use of corrosion inhibitors, to modify the chemical composition of the water such that the effects of corrosion are minimized; (b) chemical testing of the water so that the water treatment program maintains the water chemistry within acceptable guidelines; and (c) inspections to determine the presence or extent of degradation. The program uses as applicable, EPRI 1007820, Closed Cooling Water Chemistry Guideline, and includes corrosion coupon testing and microbiological testing.	Program and SLR enhancements, when applicable, are implemented 6 months prior to the subsequent period of extended operation.
XI.M22	Boraflex Monitoring	The program consists of: (a) neutron attenuation testing ("blackness testing") to determine gap formation, (b) sampling for the presence of silica in the spent fuel pool along with boron loss, and (c) monitoring and analysis of criticality to assure that the required 5% subcriticality margin is maintained. This program is implemented in response to NRC GL 96-04.	Program and SLR enhancements, when applicable, are implemented 6 months prior to the subsequent period of extended operation.
XI.M23	Inspection of Overhead Heavy Load and Light Load Handling Related to Refueling) Handling Systems	The program evaluates the effectiveness of maintenance monitoring activities for cranes and hoists. The program includes periodic visual inspections to detect loss of material due to corrosion, wear, cracking, and indications of loss of preload for load handling bridges, structural members, structural components and bolted connections. This program relies on the guidance in NUREG–0612, ASME B30.2, and other appropriate standards in the ASME B30 series. These cranes must also comply with the maintenance rule requirements provided in 10 CFR 50.65.	Program and SLR enhancements, when applicable, are implemented 6 months prior to the subsequent period of extended operation.

Table XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management Programs

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*
XI.M24	Compressed Air Monitoring	The program consists of monitoring moisture content and corrosion, and performance of the compressed air system, including (a) preventive monitoring of water (moisture), and other contaminants to keep within the specified limits and (b) inspection of components for indications of loss of material due to corrosion. This program is in response to NRC GL 88-14 and INPO's SOER 88-01. It also relies on the guidance from the ASME operations and maintenance standards and guides (ASME OM-S/G-2012, Division 2, Part 28) and ANSI/ISA-~~S~~7.0.1-1996, and EPRI TR–10847 for testing and monitoring air quality and moisture. Additionally, periodic opportunistic visual inspections of component internal surfaces are performed for signs of loss of material due to corrosion.	Program and SLR enhancements, when applicable, are implemented 6 months prior to the subsequent period of extended operation.
XI.M25	BWR Reactor Water Cleanup System	This program includes ISI and monitoring and control of reactor coolant water chemistry. Related to the inspection guidelines for the RWCU inspections of RWCU piping welds that are located outboard of the second containment isolation valve, the program includes measures delineated in per the guidelines of NUREG–0313, Revision 2, and NRC GL 88-01, GL 88-01 Supplement 1, and any applicable NRC-approved alternatives to these guidelines and ISI in conformance with the ASME Code Section XI.	Program and SLR enhancements, when applicable, are implemented 6 months prior to the subsequent period of extended operation.
XI.M26	Fire Protection	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 assemblies, and periodic visual inspection and functional tests of fire-rated doors to so that their operability is maintained. The program also includes periodic inspection and testing of halon/carbon dioxide or clean agent fire suppression systems.	Program and SLR enhancements, when applicable, are implemented 6 months prior to the subsequent period of extended operation.

Table XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management Programs			
AMP	**GALL-SLR Program**	**Description of Program**	**Implementation Schedule***
XI.M27	Fire Water System	This program is a condition monitoring program that manages aging effects associated with water-based fire protection system components. This program manages loss of material, cracking, and flow blockage due to fouling by conducting periodic visual inspections, tests, and flushes performed in accordance with the 2011 Edition of NFPA 25. Testing or replacement of sprinklers that have been in place for 50 years is performed in accordance with NFPA 25. In addition to NFPA codes and standards, portions of the water-based fire protection system that are: (a) normally dry but periodically subjected to flow and (b) cannot be drained or allow water to collect are subjected to augmented testing beyond that specified in NFPA 25, including: (a) periodic system full flow tests at the design pressure and flow rate or internal visual inspections and (b) piping volumetric wall-thickness examinations. The water-based fire protection system is normally maintained at required operating pressure and is monitored such that loss of system pressure is immediately 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 sufficient 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 follow site procedures that include inspection parameters for items such as lighting, distance, offset, presence of protective coatings, and cleaning processes for an adequate examination.	Program is 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 XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management Programs

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*
XI.M29	Outdoor and Large Atmospheric Metallic Storage Tanks	This program is a condition monitoring program that manages aging effects associated with outdoor tanks sited on soil or concrete, indoor large-volume tanks containing water designed with internal pressures approximating atmospheric pressure that are sited on concrete or soil, and other indoor tanks that sit on, or are embedded in concrete, where plant-specific operating experience indicates that the tank surfaces are periodically exposed to moisture, including the [applicant to list the specific tanks that are in the program scope]. The program includes preventive measures to mitigate corrosion by protecting the external surfaces of steel components per standard industry practice. Sealant or caulking is used for outdoor tanks at the concrete-component interface. This program manages loss of material and cracking by conducting periodic internal and external visual and surface examinations. Inspections of caulking or sealant are supplemented with physical manipulation. Surface exams are conducted to detect cracking when susceptible materials are used. [The applicant can modify this sentence if it is demonstrated that any in-scope stainless steel or aluminum tanks are not susceptible to SCC or loss of material based on the results of SRP-SLR Sections 3.1.2.2.16, 3.2.2.2.4, 3.3.2.2.3, 3.4.2.2.2, 3.2.2.2.2, 3.3.2.2.4, 3.4.2.2.3, 3.2.2.2.8, 3.3.2.2.8, 3.4.2.2.7, 3.2.2.2.10, 3.3.2.2.10, and 3.4.2.2.9.] Thickness measurements of tank bottoms are conducted to detect degradation. The external surfaces of insulated tanks are periodically sampling-based inspected. Inspections not conducted in accordance with ASME Code Section XI requirements are conducted in accordance with plant-specific procedures including inspection parameters such as lighting, distance, offset, and surface conditions.	Program is implemented and inspections or tests begin 10 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 XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management Programs			
AMP	**GALL-SLR Program**	**Description of Program**	**Implementation Schedule***
XI.M30	Fuel Oil Chemistry	This program relies on a combination of surveillance and maintenance procedures. Fuel oil quality is maintained by monitoring and controlling fuel oil contamination in accordance with the plant's technical specifications. Guidelines of the ASTM Standards, such as ASTM D 0975, D 1796, D 2276, D 2709, D 6217, and D 4057, also may be used. Exposure to fuel oil contaminants, such as water and microbiological organisms, is minimized by periodic cleaning/draining of tanks and by verifying the quality of new oil before its introduction into the storage tanks.	Program is implemented and inspections begin 10 years before the subsequent period of extended operation. Inspections 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.
XI.M31	Reactor Vessel Material Surveillance	This program requires implementation of a reactor vessel material surveillance program to monitor the changes in fracture toughness to the ferritic reactor vessel beltline materials which are projected to receive a peak neutron fluence at the end of the design life of the vessel exceeding 10^{17} n/cm^2 (E >1MeV). The surveillance capsules must be located near the inside vessel wall in the beltline region so that the material specimens duplicate, to the greatest degree possible, the neutron spectrum, temperature history, and maximum neutron fluence experienced at the reactor vessel's inner surface. Because of the resulting lead factors, surveillance capsules receive equivalent neutron fluence exposures earlier than the inner surface of the reactor vessel. This allows surveillance capsules to be withdrawn prior to the inner surface receiving an equivalent neutron fluence and therefore test results may	Program and SLR enhancements, when applicable, are implemented 6 months prior to the subsequent period of extended operation. This program includes removal and testing of at least one capsule during the subsequent period of extended

Table XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management Programs			
AMP	**GALL-SLR Program**	**Description of Program**	**Implementation Schedule***
		bound the corresponding operating period in the capsule withdrawal schedule. This surveillance program must comply with ASTM International (formerly American Society for Testing and Materials) Standard Practice E 185-82, as incorporated by reference in 10 CFR Part 50, Appendix H. Because the withdrawal schedule in Table 1 of ASTM E 185-82 is based on plant operation during the original 40-year initial license term, standby capsules may need to be incorporated into the Appendix H program for appropriate monitoring during the subsequent period of extended operation. Surveillance capsules are designed and located to permit insertion of replacement capsules. If standby capsules will be incorporated into the Appendix H program for the subsequent period of extended operation and have been removed from the reactor vessel, these should be reinserted so that appropriate lead factors are maintained and test results will bound the corresponding operating period. This program includes removal and testing of at least one capsule during the subsequent period of extended operation, with a neutron fluence of the capsule between one and two times the projected peak vessel neutron fluence at the end of the subsequent period of extended operation. As an alternative to a plant-specific surveillance program complying with ASTM E 185-82, an ISP may be considered for a set of reactors that have similar design and operating features, in accordance with 10 CFR Part 50, Appendix H, Paragraph III.C. The plant-specific implementation of the ISP is consistent with the latest version of the ISP plan that has received approval by the NRC for the subsequent period of extended operation. The objective of this Reactor Vessel Material Surveillance program is to provide sufficient material data and dosimetry to (a) monitor irradiation embrittlement to neutron fluences greater than the projected neutron fluence at the end of the subsequent period of operation, and (b) provide adequate dosimetry monitoring during the operational period. If surveillance capsules are not withdrawn during the subsequent period of	operation, with a neutron fluence of the capsule between one and two times the projected peak vessel neutron fluence at the end of the subsequent period of extended operation.

Table XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management Programs			
AMP	GALL-SLR Program	Description of Program	Implementation Schedule*
		extended operation, provisions are made to perform dosimetry monitoring. This program is a condition monitoring program that measures the increase in Charpy V-notch 30 ft-lb transition temperature and the drop in the upper-shelf energy as a function of neutron fluence and irradiation temperature. The data from this surveillance program are used to monitor neutron irradiation embrittlement of the reactor ~~vessel, and~~vessel and are inputs to the neutron embrittlement TLAAs described in Section 4.2 of the SRP-SLR. The Reactor Vessel Material Surveillance program is also used in conjunction with AMP X.M2, "Neutron Fluence Monitoring," which monitors neutron fluence for reactor vessel components and reactor vessel internal components. In accordance with 10 CFR Part 50, Appendix H, all surveillance capsules, including those previously removed from the reactor vessel, must meet the test procedures and reporting requirements of ASTM E 185-82, to the extent practicable, for the configuration of the specimens in the capsule. Any changes to the capsule withdrawal schedule, including the conversion of standby capsules into the Appendix H program and extension of the surveillance program for the subsequent period of extended operation, must be approved by the NRC prior to implementation, in accordance with 10 CFR Part 50, Appendix H, Paragraph III.B.3. Standby capsules placed in storage (e.g., removed from the reactor vessel) are maintained for possible future insertion.	

Table XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management Programs

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*
XI.M32	One-Time Inspection	The program is a condition monitoring program consisting of a one-time inspection of selected components to verify: (a) the system-wide effectiveness of an AMP that is designed to prevent or minimize aging to the extent that it will not cause the loss of intended function during the subsequent period of extended operation; (b) the insignificance of an aging effect; and (c) that long-term loss of material will not cause a loss of intended function for steel components exposed to environments that do not include corrosion inhibitors as a preventive action. The elements of the program include: (a) determination of the sample size of components to be inspected based on an assessment of materials of fabrication, environment, plausible aging effects, and operating experience, (b) identification of the inspection locations in the system or component based on the potential for the aging effect to occur, (c) determination of the examination technique, including acceptance criteria that would be effective in managing the aging effect for which the component is examined, and (d) an evaluation of the need for follow-up examinations to monitor the progression of aging if age-related degradation is found that could jeopardize an intended function before the end of the subsequent period of extended operation. Periodic inspections instead of this program are used for structures or components with known age-related degradation mechanisms or when the environment in the subsequent period of extended operation is not expected to be equivalent to that in the prior operating period. Inspections not conducted in accordance with ASME Code Section XI requirements are conducted in accordance with plant-specific procedures including inspection parameters such as lighting, distance, offset, and surface conditions.	Program is implemented and inspections begin 10 years before the subsequent period of extended operation. Inspections 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 XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management Programs			
AMP	**GALL-SLR Program**	**Description of Program**	**Implementation Schedule***
XI.M33	Selective Leaching	This program is a condition monitoring program that includes a one-time inspection for components exposed to a closed-cycle cooling water or treated water environment when plant-specific operating experience has not revealed selective leaching in these environments. Opportunistic and periodic inspections are conducted for raw water, waste water, soil, and groundwater environments, and for closed-cycle cooling water and treated water environments when plant-specific operating experience has revealed selective leaching in these environments. Visual inspections coupled with mechanical examination techniques such as chipping or scraping are conducted. Periodic destructive examinations of components for physical properties (i.e., degree of dealloying, depth of dealloying, through-wall thickness, and chemical composition) are conducted for components exposed to raw water, waste water, soil, and groundwater environments, or for closed-cycle cooling water and treated water environments when plant-specific operating experience has revealed selective leaching in these environments. Inspections and tests are conducted to determine whether loss of material will affect the ability of the components to perform their intended function for the subsequent period of extended operation. Inspections are conducted in accordance with plant-specific procedures including inspection parameters such as lighting, distance, offset and surface conditions. When the acceptance criteria are not met such that it is determined that the affected component should be replaced prior to the end of the subsequent period of extended operation, additional inspections are performed.	Program is implemented and inspections begin 10 years before the subsequent period of extended operation. Inspections 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 XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management Programs			
AMP	**GALL-SLR Program**	**Description of Program**	**Implementation Schedule***
XI.M35	ASME Code Class 1 Small Bore-Piping	This program augments the existing ASME Code, Section XI requirements and is applicable to small-bore ASME Code Class 1 piping and systems with a NPS diameter less than 4 inches and greater than or equal to 1 inch (1 ≤ NPS <4). This program provides a one-time volumetric inspection of a sample of this Class 1 piping. This program includes pipes, full and partial penetration (socket) welds. The program includes measures to verify that degradation is not occurring, thereby either confirming that there is no need to manage aging-related degradation or validating the effectiveness of any existing program for the subsequent period of extended operation. The one-time inspection program for ASME Code Class 1 small-bore piping includes locations that are susceptible to cracking. This program is applicable to systems that have not experienced cracking of ASME Code Class 1 small-bore piping. This program can also be used for systems that experienced cracking but have implemented design changes to effectively mitigate cracking. [Measure of effectiveness includes: (1) the one-time inspection sampling is statistically significant; (2) samples will be selected as described in Element 5; and (3) no repeated failures over an extended period of time.] For systems that have experienced cracking and operating experience indicates design changes have not been implemented to effectively mitigate cracking, periodic inspection is proposed, as managed by a plant-specific AMP. Should evidence of cracking be revealed by a one-time inspection, a periodic inspection is also proposed, as managed by a plant-specific AMP.	Program is implemented and inspections are completed within 6 years before the subsequent period of extended operation. Inspections 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 XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management Programs			
AMP	**GALL-SLR Program**	**Description of Program**	**Implementation Schedule***
XI.M36	External Surfaces Monitoring of Mechanical Components	This program is a condition monitoring program that manages loss of material, cracking, changes in material properties (of cementitious components), hardening or loss of strength (of elastomeric components), and reduced thermal insulation resistance. Periodic visual inspections, not to exceed a refueling outage interval, of metallic, polymeric, insulation jacketing (insulation when not jacketed), and cementitious components are conducted. Surface examinations or ASME Code Section XI VT-1 examinations are conducted to detect cracking of stainless steel and aluminum components. For certain materials, such as flexible polymers, physical manipulation or pressurization to detect hardening or loss of strength is used to augment the visual examinations conducted under this program. A sample of outdoor component surfaces that are insulated and a sample of indoor insulated components exposed to condensation (due to the in-scope component being operated below the dew point), are periodically inspected every 10 years during the subsequent period of extended operation. [The applicant can modify this sentence if it is demonstrated that any in-scope stainless steel or aluminum components are not susceptible to SCC or loss of material based on the results of SRP-SLR Sections 3.1.2.2.16, 3.2.2.2.4, 3.3.2.2.3, 3.4.2.2.2, 3.2.2.2.2, 3.3.2.2.4, 3.4.2.2.3, 3.2.2.2.8, 3.3.2.2.8, 3.4.2.2.7, 3.2.2.2.10, 3.3.2.2.10, and 3.4.2.2.9.] Inspections not conducted in accordance with ASME Code Section XI requirements are conducted in accordance with plant-specific procedures including inspection parameters such as lighting, distance, offset, and surface conditions. Acceptance criteria are such that the component will meet its intended function until the next inspection or the end of the subsequent period of extended operation. Qualitative acceptance criteria are clear enough to reasonably assure a singular decision is derived based on observed conditions.	Program and SLR enhancements, when applicable, are implemented 6 months prior to the subsequent period of extended operation.

Table XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management Programs			
AMP	**GALL-SLR Program**	**Description of Program**	**Implementation Schedule***
XI.M37	Flux Thimble Tube Inspection	The program inspects for the thinning of flux thimble tube walls, which provides a path for the in-core neutron flux monitoring system detectors and forms part of the reactor coolant system pressure boundary. Flux thimble tubes are subject to loss of material at certain locations in the reactor vessel where flow-induced fretting causes wear at discontinuities in the path from the reactor vessel instrument nozzle to the fuel assembly instrument guide tube. A periodic nondestructive examination methodology, such as eddy current testing or other applicant-justified and US NRC-accepted inspection methods is used to monitor flux thimble tube wear. This program implements the recommendations of NRC Bulletin 88-09, "Thimble Tube Thinning in Westinghouse Reactors."	Program and SLR enhancements, when applicable, are implemented 6 months prior to the subsequent period of extended operation.
XI.M38	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	This program is a condition monitoring program that manages loss of material and cracking, as well as hardening or loss of strength of polymeric materials. This program consists of visual inspections of all accessible internal surfaces of piping, piping components, ducting, heat exchanger components, polymeric and elastomeric components, and other components. Surface examinations or ASME Code Section XI VT-1 examinations are conducted to detect cracking of stainless steel and aluminum components. Aging effects associated with items (except for elastomers) within the scope of AMP XI.M20 (open-cycle cooling water), AMP XI.M21A (closed treated water system), and XI.M27 (fire water system) are not managed by this program. Applicable environments include air, gas, condensation, diesel exhaust, water, fuel oil, and lubricating oil. These internal inspections are performed during the periodic system and component surveillances or during the performance of maintenance activities when the surfaces are made accessible for visual inspection. At a minimum, in each 10-year period during the subsequent period of extended operation a representative sample of 20% of the population (defined as components having the same combination of material, environment, and aging effect) or a maximum of 25 components per population is inspected. Where practical, the inspections focus on the bounding or lead components most susceptible to aging because of time in service, and severity of operating conditions. Opportunistic inspections continue in each period despite meeting the	Program and SLR enhancements, when applicable, are implemented 6 months prior to the subsequent period of extended operation.

Table XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management Programs			
AMP	**GALL-SLR Program**	**Description of Program**	**Implementation Schedule***
		sampling limit. For certain materials, such as flexible polymers, physical manipulation or pressurization to detect hardening or loss of strength is used to augment the visual examinations conducted under this program. If visual inspection of internal surfaces is not possible, a plant-specific program is used. Inspections not conducted in accordance with ASME Code Section XI requirements are conducted in accordance with plant-specific procedures including inspection parameters such as lighting, distance, offset and surface conditions. Acceptance criteria are such that the component will meet its intended function until the next inspection or the end of the subsequent period of extended operation. Qualitative acceptance criteria are clear enough to reasonably assure a singular decision is derived based on observed conditions.	
XI.M39	Lubricating Oil Analysis	This program provides reasonable assurance that the oil environment in the mechanical systems is maintained to the required quality, and the oil systems are maintained free of contaminants (primarily water and particulates), thereby preserving an environment that is not conducive to loss of material or reduction of heat transfer. Testing activities include sampling and analysis of lubricating oil for detrimental contaminants. The presence of water or particulates may also indicate in-leakage and corrosion product buildup.	Program and SLR enhancements, when applicable, are implemented 6 months prior to the subsequent period of extended operation.
XI.M40	Monitoring of Neutron-Absorbing Materials other than Boraflex	This program relies on periodic inspection, testing, monitoring, and analysis of the criticality design to assure that the required 5% subcriticality margin is maintained. This program consists of inspecting the physical condition of the neutron-absorbing material, such as visual appearance, dimensional measurements, weight, geometric changes (e.g., formation of blisters, pits, and bulges), and boron areal density as observed from coupons or in situ.	Program and SLR enhancements, when applicable, are implemented 6 months prior to the subsequent period of extended operation.

Table XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management Programs			
AMP	**GALL-SLR Program**	**Description of Program**	**Implementation Schedule***
XI.M41	Buried and Underground Piping and Tanks	This program is a condition monitoring program that manages the aging effects associated with the external surfaces of buried and underground piping and tanks such as loss of material and cracking. It addresses piping and tanks composed of any material, including metallic, polymeric, and cementitious materials. The program also manages aging through preventive and mitigative actions (i.e., coatings, backfill quality, and cathodic protection). The number of inspections is based on the effectiveness of the preventive and mitigative actions. Annual cathodic protection surveys are conducted. For steel components, where the acceptance criteria for the effectiveness of the cathodic protection is other than -850 mV instant off, loss of material rates are measured. Inspections are conducted by qualified individuals. Where the coatings, backfill or the condition of exposed piping does not meet acceptance criteria such that the depth or extent of degradation of the base metal could have resulted in a loss of pressure boundary function when the loss of material rate is extrapolated to the end of the subsequent period of extended operation, an increase in the sample size is conducted. If a reduction in the number of inspections recommended in GALL-SLR Report, AMP XI.M41, Table XI.M41-2 is claimed based on a lack of soil corrosivity as determined by soil testing, then soil testing is conducted once in each 10-year period starting 10 years prior to the subsequent period of extended operation.	Program is implemented and inspections begin 10 years before the subsequent period of extended operation. Inspections 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 XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management Programs			
AMP	**GALL-SLR Program**	**Description of Program**	**Implementation Schedule***
XI.M42	Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks	This program is a condition monitoring program that manages degradation of internal coatings/linings exposed to closed-cycle cooling water, raw water, treated water, treated borated water, waste water, lubricating oil or fuel oil that can lead to loss of material of base materials or downstream effects such as reduction in flow, reduction in pressure or reduction of heat transfer when coatings/linings become debris. This program can also be used to manage loss of coating integrity for external coatings exposed to any air environment or condensation credited with isolating the external surface of a component from the environment (e.g., SRP-SLR Section 3.2.2.2.2). This program manages these aging effects for internal coatings by conducting periodic visual inspections of all coatings/linings applied to the internal surfaces of in-scope components where loss of coating or lining integrity could impact the component's or downstream component's current licensing basis intended function(s). Visual inspections are conducted on external surfaces when applicable. For tanks and heat exchangers, all accessible surfaces are inspected. Piping inspections are sampling-based. 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. For cementitious coatings, training and qualifications are based on an appropriate combination of education and experience related to inspecting concrete surfaces. Peeling and delamination is not acceptable. Blisters are evaluated by a coatings specialist with the blisters being surrounded by sound material and with the size and frequency not increasing. Minor cracks in cementitious coatings are acceptable provided there is no evidence of debonding. All other degraded conditions are evaluated by a coatings specialist. For coated/lined surfaces determined to not meet the acceptance criteria, physical testing is performed where physically possible (i.e., sufficient room to conduct testing) in conjunction with repair or replacement of the coating/lining.	Program is implemented and inspections begin 10 years before the subsequent period of extended operation. Inspections 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 XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management Programs

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*
XI.S1	ASME Section XI, Subsection IWE Inservice Inspection (IWE)	This program is in accordance with ASME Code Section XI, Subsection IWE, consistent with 10 CFR 50.55a "Codes and standards," with supplemental recommendations. The AMP includes periodic visual, surface, and volumetric examinations, where applicable, of metallic pressure-retaining components of steel containments and concrete containments for signs of degradation, damage, irregularities including discernable liner plate bulges, and for coated areas distress of the underlying metal shell or liner, and corrective actions. Acceptability of inaccessible areas of steel containment shell or concrete containment steel liner is evaluated when conditions found in accessible areas indicate the presence of, or could result in, flaws or degradation in inaccessible areas. This program also includes aging management for the potential loss of material due to corrosion in the inaccessible areas of the BWR Mark I steel containment. In addition, the program includes supplemental surface examination to detect cracking for specific pressure-retaining components [identify components] subject to cyclic loading but have no CLB fatigue analysis; and if triggered by plant-specific operating experience, a one-time supplemental volumetric examination by sampling randomly-selected as well as focused locations susceptible to loss of thickness due to corrosion of containment shell or liner that is inaccessible from one side. Inspection results are compared with prior recorded results in acceptance of components for continued service.	Program and SLR enhancements, when applicable, are implemented 6 months prior to the subsequent period of extended operation and if triggered by plant-specific operating experience, a one-time supplemental volumetric examination by sampling randomly-selected as well as focused locations susceptible to loss of thickness due to corrosion of containment shell or liner that is inaccessible from one side is 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 XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management Programs			
AMP	**GALL-SLR Program**	**Description of Program**	**Implementation Schedule***
XI.S2	ASME Section XI, Subsection IWL Inservice Inspection (IWL)	This program consists of: (a) periodic visual inspection of concrete surfaces for reinforced and pre-stressed concrete containments, (b) periodic visual inspection and sample tendon testing of un-bonded post-tensioning systems for pre-stressed concrete containments for signs of degradation, assessment of damage, and corrective actions, and testing of the tendon corrosion protection medium and free water. Measured tendon lift-off forces are compared to predicted tendon forces calculated in accordance with RG 1.35.1. The Subsection IWL requirements are supplemented to include quantitative acceptance criteria for evaluation of concrete surfaces based on the "Evaluation Criteria" provided in Chapter 5 of ACI 349.3R.	Program and SLR enhancements, when applicable, are implemented 6 months prior to the subsequent period of extended operation.

Table XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management Programs

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*
XI.S3	ASME Section XI, Subsection IWF Inservice inspection (IWF)	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 50.55a ASME Code Section XI, Subsection IWF program. This consists of a one-time inspection of an additional 5% of the sample size specified in Table IWF-2500-1 for Class 1, 2, and 3 piping supports. This one-time inspection is conducted within 5 years prior to entering the subsequent period of extended operation. For high-strength bolting in sizes greater than ~~1 inch~~1-inch nominal diameter, volumetric examination comparable to that of ASME Code Section XI, Table IWB-2500-1, Examination Category B-G-1 should be 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.	Program is implemented and a one-time inspection of an additional 5% of the sample size specified in Table IWF-2500-1 for Class 1, 2, and 3 piping supports is conducted within 5 years prior to the subsequent period of extended operation, and 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.
XI.S4	10 CFR Part 50, Appendix J	This program consists of monitoring leakage rates through the containment system, its shell or 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. This program is implemented in accordance with 10 CFR Part 50 Appendix J, RG 1.163 and/or NEI 94-01, and subject to the requirements of 10 CFR Part 54.	Program and SLR enhancements, when applicable, are implemented 6 months prior to the subsequent period of extended operation.

Table XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management Programs

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*
XI.S5	Masonry Walls	This program consists of inspections, based on IEB 80-11 and plant-specific monitoring proposed by 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.	Program and SLR enhancements, when applicable, are implemented 6 months prior to the subsequent period of extended operation.
XI.S6	Structures Monitoring	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, SEI/ASCE 11, 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.	Program and SLR enhancements, when applicable, are implemented 6 months prior to the subsequent period of extended operation.
XI.S7	Inspection of Water-Control Structures Associated with Nuclear Power Plants	This program consists of inspection and surveillance of raw-water control structures associated with emergency cooling systems or flood protection. The program also includes structural steel and structural bolting associated with water-control structures. In general, parameters monitored are in accordance with Section C.2 of RG 1.127 and quantitative measurements should be recorded for findings that exceed the acceptance criteria for applicable parameters monitored or inspected. Inspections should occur at least once every 5 years. Structures exposed to aggressive water require additional plant-specific investigation.	Program and SLR enhancements, when applicable, are implemented 6 months prior to the subsequent period of extended operation.

Table XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management Programs			
AMP	**GALL-SLR Program**	**Description of Program**	**Implementation Schedule***
XI.S8	Protective Coating Monitoring and Maintenance	This program ensures that a monitoring and maintenance program implemented in accordance with RG 1.54 is adequate for the subsequent period of extended operation. The program consists of guidance for selection, application, inspection, and maintenance of protective coatings. Maintenance of Service Level I coatings applied to carbon steel and concrete surfaces inside containment (e.g., steel liner, steel containment shell, structural steel, supports, penetrations, and concrete walls and floors) serve to prevent or minimize loss of material due to corrosion of carbon steel components and aids in decontamination. Degraded coatings in the containment are assessed periodically to ensure post-accident operability of the ECCS.	Program and SLR enhancements, when applicable, are implemented 6 months prior to the subsequent period of extended operation.
SRP-SLR Appendix A	Plant-Specific AMP	The [fill in name of program] Program is a [prevention, mitigation, condition monitoring, performance monitoring] program that manages aging effects associated with [list component type or system as applicable that are in the scope of the program]. Preventive or mitigative actions include [fill in key actions when applicable]. The program manages [list the AERM] by conducting [periodic, one-time] [describe inspection methods and tests] of [all components or a representative sample of components] within the scope of the program. [When applicable, periodic inspections are conducted every XX years commencing prior to or during the subsequent period of extended operation.] [Describe how inspection and test implementing procedures are controlled (e.g., non-ASME 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).] Qualitative acceptance criteria are clear enough to reasonably ensure a singular decision is derived based on observed conditions. When the acceptance criteria are not met such that it is determined that the affected component should be replaced prior to the end of the subsequent period of extended operation, additional inspections are performed.	Program is implemented 6 months prior to the subsequent period of extended operation.

Proposed Revisions to SRP-SLR Table 3.6-1

Table 3.6-1	Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the GALL-SLR Report						
New, Modified, Deleted, Edited Item	**ID**	**Type**	**Component**	**Aging Effect/Mechanism**	**Aging Management Program (AMP)/TLAA**	**Further Evaluation Recommended**	**GALL-SLR Item**
M	001	BWR/PWR	Electrical equipment subject to 10 CFR 50.49 EQ requirements composed of various polymeric and metallic materials in plant areas subject to a harsh environment (i.e., loss of coolant accident (LOCA), high energy line break (HELB), or post LOCA environment or, An adverse localized environment for the most limiting qualified condition for temperature, radiation, or moisture for the component material (e.g., cable or connection insulation).	Various aging effects due to various mechanisms in accordance with 10 CFR 50.49	EQ is a time-limited aging analysis (TLAA) to be evaluated for the subsequent period of extended operation. See the Standard Review Plan, Section 4.4, "Environmental Qualification (EQ) of Electric Equipment," for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1)(i) and (ii). See AMP X.E1, "Environmental Qualification (EQ) of Electric Equipment," of this report for meeting the requirements of 10 CFR 54.21(c)(1)(i)-(iii).	Yes, TLAA (SRP-SLR Section 3.6.2.2.1)	VI.B.L-05

Table 3.6-1	Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the GALL-SLR Report						
New, Modified, Deleted, Edited Item	**ID**	**Type**	**Component**	**Aging Effect/Mechanism**	**Aging Management Program (AMP)/TLAA**	**Further Evaluation Recommended**	**GALL-SLR Item**
M	002	BWR/PWR	High-voltage electrical insulators composed of porcelain; malleable iron; aluminum; galvanized steel; cement; toughened glass; polymers; silicone rubber; fiber glass, aluminum alloy exposed to air – outdoor	Loss of material due to mechanical wear caused by movement of transmission conductors due to significant wind, and wind-driven particles impacting surfaces	AMP XI.E7, "High-Voltage Insulators"	No	VI.A.LP-32
M	003	BWR/PWR	High-voltage insulators composed of porcelain; malleable iron; aluminum; galvanized steel; cement; toughened glass; polymers; silicone rubber; fiber glass, aluminum alloy exposed to air – outdoor	Reduced electrical insulation resistance due to presence of salt deposits, ~~or~~ surface contamination, or peeling of silicone rubber sleeves for polymer insulators	AMP XI.E7, "High-Voltage Insulators"	No	VI.A.LP-28
E	004	BWR/PWR	Transmission conductors composed of aluminum; steel exposed to air – outdoor	Loss of conductor strength due to corrosion	A plant-specific aging management program is to be evaluated for ACSR	Yes (SRP-SLR Section 3.6.2.2.3)	VI.A.LP-38
E	005	BWR/PWR	Transmission connectors composed of aluminum; steel exposed to air – outdoor	Increased electrical resistance of connection due to oxidation or loss of pre-load	A plant-specific aging management program is to be evaluated	Yes (SRP-SLR Section 3.6.2.2.3)	VI.A.LP-48

Table 3.6-1	Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the GALL-SLR Report						
New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
E	006	BWR/PWR	Switchyard bus and connections composed of aluminum; copper; bronze; stainless steel; galvanized steel exposed to air – outdoor	Loss of material due to wind-induced abrasion; Increased electrical resistance of connection due to oxidation or loss of pre-load	A plant-specific aging management program is to be evaluated	Yes (SRP-SLR Section 3.6.2.2.3)	VI.A.LP-39
E	007	BWR/PWR	Transmission conductors composed of aluminum; steel exposed to air – outdoor	Loss of material due to wind-induced abrasion	A plant-specific aging management program is to be evaluated for All Aluminum Conductor (AAC), ACAR and ACSR	Yes (SRP-SLR Section 3.6.2.2.3)	VI.A.LP-47
E	008	BWR/PWR	Electrical insulation for electrical cables and connections (including terminal blocks, etc.) composed of various organic polymers (e.g., EPR, SR, EPDM, XLPE) exposed to an adverse localized environment caused by heat, radiation, or moisture	Reduced electrical insulation resistance due to thermal/thermoxidative degradation of organics, radiolysis, and photolysis (UV sensitive materials only) of organics; radiation-induced oxidation; moisture intrusion	AMP XI.E1, "Electrical Insulation for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements"	No	VI.A.LP-33

Table 3.6-1 Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the GALL-SLR Report

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
E	009	BWR/PWR	Electrical insulation for electrical cables and connections used in instrumentation circuits that are sensitive to reduction in conductor insulation resistance (IR) composed of various organic polymers (e.g., EPR, SR, EPDM, XLPE) exposed to an adverse localized environment caused by heat, radiation, or moisture	Reduced electrical insulation resistance due to thermal/thermoxidative degradation of organics, radiolysis, and photolysis (UV sensitive materials only) of organics; radiation-induced oxidation; moisture intrusion	AMP XI.E2, "Electrical Insulation for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits"	No	VI.A.LP-34

Table 3.6-1	Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the GALL-SLR Report						
New, Modified, Deleted, Edited Item	**ID**	**Type**	**Component**	**Aging Effect/Mechanism**	**Aging Management Program (AMP)/TLAA**	**Further Evaluation Recommended**	**GALL-SLR Item**
M	010	BWR/PWR	Electrical conductor insulation for inaccessible power, instrumentation, and control cables (e.g., installed in duct bank, buried conduit or direct buried) composed of various organic polymers such as EPR, SR, EPDM, XLPE, butyl rubber, and combined thermoplastic jacket/insulation shield exposed to an adverse localized environment caused by significant moisture	Reduced electrical insulation resistance or degraded dielectric strength due to significant moisture	AMP XI.E3A, "Electrical Insulation for Inaccessible Medium-Voltage Power Cables Not Subject To 10 CFR 50.49 Environmental Qualification Requirements," AMP XI.E3B, "Electrical Insulation for Inaccessible Instrument and Control Cables Not Subject To 10 CFR 50.49 Environmental Qualification Requirements," or AMP XI.E3C, "Electrical Insulation for Inaccessible Low-Voltage Power Cables Not Subject To 10 CFR 50.49 Environmental Qualification Requirements"	No	VI.A.LP-35a VI.A.LP-35b VI.A.LP-35c
	011	BWR/PWR	Metal enclosed bus: enclosure assemblies composed of elastomers exposed to air – indoor controlled or uncontrolled, air – outdoor	Surface cracking, crazing, scuffing, dimensional change (e.g. "ballooning" and "necking"), shrinkage, discoloration, hardening or loss of strength due to elastomer degradation	AMP XI.E4, "Metal Enclosed Bus," or AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VI.A.LP-29

Table 3.6-1	Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the GALL-SLR Report						
New, Modified, Deleted, Edited Item	**ID**	**Type**	**Component**	**Aging Effect/Mechanism**	**Aging Management Program (AMP)/TLAA**	**Further Evaluation Recommended**	**GALL-SLR Item**
E	012	BWR/PWR	Metal enclosed bus: bus/connections composed of various metals used for electrical bus and connections exposed to air – indoor controlled or uncontrolled, air – outdoor	Increased electrical resistance of connection due to the loosening of bolts caused by thermal cycling and ohmic heating	AMP XI.E4, "Metal Enclosed Bus"	No	VI.A.LP-25
E	013	BWR/PWR	Metal enclosed bus: electrical insulation; insulators composed of porcelain; xenoy; thermo-plastic organic polymers exposed to air – indoor controlled or uncontrolled, air – outdoor	Reduced electrical insulation resistance due to thermal/thermoxidative degradation of organics/thermoplastics , radiation-induced oxidation, moisture/debris intrusion, and ohmic heating	AMP XI.E4, "Metal Enclosed Bus"	No	VI.A.LP-26
	014	BWR/PWR	Metal enclosed bus: external surface of enclosure assemblies composed of steel exposed to air – indoor uncontrolled, air – outdoor	Loss of material due to general, pitting, crevice corrosion	AMP XI.E4, "Metal Enclosed Bus," or AMP XI.S6, "Structures Monitoring"	No	VI.A.LP-43
	015	BWR/PWR	Metal enclosed bus: external surface of enclosure assemblies composed of galvanized steel; aluminum exposed to air – outdoor	Loss of material due to pitting, crevice corrosion	AMP XI.E4, "Metal Enclosed Bus," or AMP XI.S6, "Structures Monitoring"	No	VI.A.LP-42

Table 3.6-1 Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the GALL-SLR Report

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	016	BWR/PWR	Fuse holders (not part of active equipment): metallic clamps composed of various metals used for electrical connections exposed to air – indoor uncontrolled	Increased electrical resistance of connection due to chemical contamination, corrosion, and oxidation (in an air, indoor controlled environment, increased resistance of connection due to chemical contamination, corrosion and oxidation do not apply)	AMP XI.E5, "Fuse Holders" No aging management program is required for those applicants who can demonstrate these fuse holders are located in an environment that does not subject them to environmental aging mechanisms and effects due to chemical contamination, corrosion, and oxidation.	No	VI.A.LP-23
N	017	BWR/PWR	Fuse holders (not part of active equipment): metallic clamps composed of various metals used for electrical connections exposed to air-indoor controlled or uncontrolled	Increased electrical resistance of connection due to fatigue from ohmic heating, thermal cycling, electrical transients	AMP XI.E5, "Fuse Holders" No aging management program is required for those applicants who can demonstrate these fuse holders are not subject to fatigue due to ohmic heating, thermal cycling, electrical transients.	No	VI.A.L-07
M	018	BWR/PWR	Fuse holders (not part of active equipment): metallic clamps composed of various metals used for electrical connections exposed to air – indoor controlled or uncontrolled	Increased electrical resistance of connection due to fatigue caused by frequent fuse removal/manipulation or vibration	AMP XI.E5, "Fuse Holders" No aging management program is required for those applicants who can demonstrate these fuse holders are not subject to fatigue caused by frequent fuse removal/manipulation or vibration.	No	VI.A.LP-31

Table 3.6-1	Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the GALL-SLR Report						
New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
E	019	BWR/PWR	Cable connections (metallic parts) composed of various metals used for electrical contacts exposed to air – indoor controlled or uncontrolled, air – outdoor	Increased electrical resistance of connection due to thermal cycling, ohmic heating, electrical transients, vibration, chemical contamination, corrosion, and oxidation	AMP XI.E6, "Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements"	No	VI.A.LP-30
E	020	PWR	Electrical connector contacts for electrical connectors composed of various metals used for electrical contacts exposed to air with borated water leakage	Increased electrical resistance of connection due to corrosion of connector contact surfaces caused by intrusion of borated water	AMP XI.M10, "Boric Acid Corrosion"	No	VI.A.LP-36
M	021	BWR/PWR	Transmission conductors composed of aluminum exposed to air – outdoor	Loss of conductor strength due to corrosion	None - for ACAR and All Aluminum Conductor (AAC)	No	VI.A.LP-46
M	022	BWR/PWR	Fuse holders (not part of active equipment): insulation material composed of electrical insulation material: bakelite; phenolic melamine or ceramic; molded polycarbonate, and other, exposed to air – indoor controlled or uncontrolled	Reduced electrical insulation resistance due to thermal/thermoxidative degradation of organics, radiolysis, and photolysis (UV sensitive materials only) of organics; radiation-induced oxidation; moisture intrusion	AMP XI.E5, "Fuse Holders" No aging management program is required for those applicants who can demonstrate these fuse holders are located in an environment that does not subject them to environmental aging mechanisms	No	VI.A.LP-24

Table 3.6-1 Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the GALL-SLR Report

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
N	023	BWR/PWR	Metal enclosed bus: external surface of enclosure assemblies. Galvanized steel; aluminum. air – indoor controlled or uncontrolled	None	None	No	VI.A.LP-41
N	024	BWR/PWR	Metal enclosed bus: external surface of enclosure assemblies. Steel air – indoor controlled	None	None	No	VI.A.LP-44
D	026						
N	027	BWR/PWR	Cable bus: external surface of enclosure assemblies galvanized steel; aluminum; air – indoor controlled or uncontrolled	None	None	No	VI.A.L-09
D	028						
N	029	BWR/PWR	Cable bus: electrical insulation; insulators – exposed to air – indoor controlled or uncontrolled, air – outdoor	Reduced electrical insulation resistance due to degradation caused thermal/thermoxidative degradation of organics and photolysis (UV sensitive materials only) of organics, moisture/debris intrusion and ohmic heating	A plant-specific aging management program is to be evaluated	Yes (SRP-SLR Section 3.6.2.2.2)	VI.A.L-11

Table 3.6-1 Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the GALL-SLR Report

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
N	030	BWR/PWR	Cable bus: external surface of enclosure assemblies composed of steel exposed to air – indoor uncontrolled or air – outdoor	Loss of material due to general, pitting, crevice corrosion	A plant-specific aging management program is to be evaluated	Yes (SRP-SLR Section 3.6.2.2.2)	VI.A.L-12
N	031	BWR/PWR	Cable bus external surface of enclosure assemblies composed of galvanized steel; aluminum exposed to air – outdoor	Loss of material due to general, pitting, crevice corrosion	A plant-specific aging management program is to be evaluated	Yes (SRP-SLR Section 3.6.2.2.2)	VI.A.L-13
N	032	BWR/PWR	Cable bus: external surface of enclosure assemblies: composed of steel; air – indoor controlled	None	None	No	VI.A.L-14

Proposed Revisions to GALL-SLR Table VI (This table is reproduced below in its entirety. Only items VI.A.LP-32 and VI.A.LP-28 contain proposed revisions.)

VI Table A	ELECTRICAL COMPONENTS Equipment Not Subject to 10 CFR 50.49 Environmental Qualification Requirements							
New, Modified, Deleted, Edited Item	**Item**	**SRP Item (Table, ID)**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/Mechanism**	**Aging Management Program (AMP)/TLAA**	**Further Evaluation**
N	VI.A.L-11	3.6-1, 029	Cable Bus	Electrical insulation; insulators	Air – indoor controlled or uncontrolled, air – outdoor	Reduced electrical insulation resistance due to degradation caused thermal/thermoxidative degradation of organics and photolysis (UV sensitive materials only) of organics, moisture/debris intrusion and ohmic heating	A plant-specific aging management program is to be evaluated	Yes
N	VI.A.L-09	3.6-1, 027	Cable Bus: external surface of enclosure assemblies	Galvanized steel; aluminum	Air – indoor controlled or uncontrolled	None	None	No
N	VI.A.L-13	3.6-1, 031	Cable Bus: external surface of enclosure assemblies	Galvanized steel; aluminum	Air – outdoor	Loss of material due to general, pitting, crevice corrosion	A plant-specific aging management program is to be evaluated	Yes
N	VI.A.L-14	3.6-1, 032	Cable Bus: external surface of enclosure assemblies	Steel	Air – indoor controlled	None	None	No
N	VI.A.L-12	3.6-1, 030	Cable Bus: external surface of enclosure assemblies	Steel	Air – indoor uncontrolled, air – outdoor	Loss of material due to general, pitting, crevice corrosion	A plant-specific aging management program is to be evaluated	Yes

VI ELECTRICAL COMPONENTS
Table A Equipment Not Subject to 10 CFR 50.49 Environmental Qualification Requirements

New, Modified, Deleted, Edited Item	Item	SRP Item (Table, ID)	Structure and/or Component	Material	Environment	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation
E	VI.A.LP-30	3.6-1, 019	Cable connections (metallic parts)	Various metals used for electrical contacts	Air – indoor controlled or uncontrolled, air – outdoor	Increased electrical resistance of connection due to thermal cycling, ohmic heating, electrical transients, vibration, chemical contamination, corrosion, oxidation	AMP XI.E6, "Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements"	No
M	VI.A.LP-35b	3.6-1, 010	Electrical conductor insulation for inaccessible instrumentation and control cables (e.g., installed in duct bank, buried conduit or direct buried)	Various organic polymers such as EPR, SR, EPDM, XLPE, butyl rubber, and combined thermoplastic jacket/insulation shield	Adverse localized environment caused by significant moisture	Reduced electrical insulation resistance or degraded dielectric strength due to significant moisture	AMP XI.E3B, "Electrical Insulation for Inaccessible Instrument and Control Cables Not Subject To 10 CFR 50.49 Environmental Qualification Requirements"	No
M	VI.A.LP-35c	3.6-1, 010	Electrical conductor insulation for inaccessible low-voltage cables - typical operating voltage of < 1 kV but no greater than 2 kV (e.g., installed in duct bank, buried conduit or direct buried)	Various organic polymers such as EPR, SR, EPDM, XLPE, butyl rubber, and combined thermoplastic jacket/insulation shield	Adverse localized environment caused by significant moisture	Reduced electrical insulation resistance or degraded dielectric strength due to significant moisture	AMP XI.E3C, "Electrical Insulation for Inaccessible Low-Voltage Power Cables Not Subject To 10 CFR 50.49 Environmental Qualification Requirements"	No

VI ELECTRICAL COMPONENTS
Table A Equipment Not Subject to 10 CFR 50.49 Environmental Qualification Requirements

New, Modified, Deleted, Edited Item	Item	SRP Item (Table, ID)	Structure and/or Component	Material	Environment	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation
M	VI.A.LP-35a	3.6-1, 010	Electrical conductor insulation for inaccessible medium-voltage cables -typical operating range of 2 kV to 35 kV (e.g., installed in duct bank, buried conduit or direct buried)	Various organic polymers such as EPR, SR, EPDM, XLPE, butyl rubber, and combined thermoplastic jacket/insulation shield	Adverse localized environment caused by significant moisture	Reduced electrical insulation resistance or degraded dielectric strength due to significant moisture	AMP XI.E3A, "Electrical Insulation for Inaccessible Medium-Voltage Power Cables Not Subject To 10 CFR 50.49 Environmental Qualification Requirements"	No
E	VI.A.LP-36	3.6-1, 020	Electrical connector contacts for electrical connectors	Various metals used for electrical contacts	Air with borated water leakage	Increased electrical resistance of connection due to corrosion of connector contact surfaces caused by intrusion of borated water	AMP XI.M10, "Boric Acid Corrosion"	No
E	VI.A.LP-33	3.6-1, 008	Electrical insulation for electrical cables and connections (including terminal blocks, etc.)	Various organic polymers (e.g., EPR, SR, EPDM, XLPE)	Adverse localized environment caused by heat, radiation, or moisture	Reduced electrical insulation resistance due to thermal/thermoxidative degradation of organics, radiolysis, and photolysis (UV sensitive materials only) of organics; radiation-induced oxidation; moisture intrusion	AMP XI.E1, "Electrical Insulation for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements"	No

VI Table A	ELECTRICAL COMPONENTS Equipment Not Subject to 10 CFR 50.49 Environmental Qualification Requirements							
New, Modified, Deleted, Edited Item	**Item**	**SRP Item (Table, ID)**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/Mechanism**	**Aging Management Program (AMP)/TLAA**	**Further Evaluation**
E	VI.A.LP-34	3.6-1, 009	Electrical insulation for electrical cables and connections used in instrumentation circuits that are sensitive to reduction in conductor electrical insulation resistance (IR)	Various organic polymers (e.g., EPR, SR, EPDM, XLPE)	Adverse localized environment caused by heat, radiation, or moisture	Reduced electrical insulation resistance due to thermal/thermoxidative degradation of organics, radiolysis, and photolysis (UV sensitive materials only) of organics; radiation-induced oxidation; moisture intrusion	AMP XI.E2, "Electrical Insulation for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits"	No
M	VI.A.LP-24	3.6-1, 022	Fuse holders (not part of active equipment): electrical insulation	Electrical insulation: bakelite; phenolic melamine or ceramic; molded polycarbonate; other	Air – indoor controlled or uncontrolled	Reduced electrical insulation resistance due to thermal/thermoxidative degradation of organics, radiolysis, and photolysis (UV sensitive materials only) of organics; radiation-induced oxidation; moisture intrusion	AMP XI.E5, "Fuse Holders" No aging management program is required for those applicants who can demonstrate these fuse holders are located in an environment that does not subject them to environmental aging mechanisms.	No

VI Table A	ELECTRICAL COMPONENTS Equipment Not Subject to 10 CFR 50.49 Environmental Qualification Requirements							
New, Modified, Deleted, Edited Item	**Item**	**SRP Item (Table, ID)**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/Mechanism**	**Aging Management Program (AMP)/TLAA**	**Further Evaluation**
M	VI.A.LP-31	3.6-1, 018	Fuse holders (not part of active equipment): metallic clamps	Various metals used for electrical connections	Air – indoor controlled or uncontrolled	Increased electrical resistance of connection due to fatigue caused by frequent fuse removal/manipulation or vibration	AMP XI.E5, "Fuse Holders" No aging management program is required for those applicants who can demonstrate these fuse holders are located in an environment that does not subject them to environmental aging mechanisms and effects including fatigue caused by frequent fuse removal/manipulation or vibration.	No
N	VI.A.L-07	3.6-1, 017	Fuse holders (not part of active equipment): metallic clamps	Various metals used for electrical connections	Air – indoor controlled or uncontrolled	Increased electrical resistance of connection due to fatigue due to ohmic heating, thermal cycling, electrical transients	AMP XI.E5, "Fuse Holders" No aging management program is required for those applicants who can demonstrate these fuse holders are not subject to fatigue due to ohmic heating, thermal cycling, electrical transients.	No

VI Table A	ELECTRICAL COMPONENTS Equipment Not Subject to 10 CFR 50.49 Environmental Qualification Requirements							
New, Modified, Deleted, Edited Item	**Item**	**SRP Item (Table, ID)**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/Mechanism**	**Aging Management Program (AMP)/TLAA**	**Further Evaluation**
M	VI.A.LP-23	3.6-1, 016	Fuse holders (not part of active equipment): metallic clamps	Various metals used for electrical connections	Air – indoor uncontrolled	Increased electrical resistance of connection due to chemical contamination, corrosion, and oxidation (in an air, indoor controlled environment, increased resistance of connection due to chemical contamination, corrosion and oxidation do not apply)	AMP XI.E5, "Fuse Holders" No aging management program is required for those applicants who can demonstrate these fuse holders are located in an environment that does not subject them to environmental aging mechanisms and effects due to chemical contamination, corrosion, and oxidation.	No
M	VI.A.LP-32	3.6-1, 002	High-voltage electrical insulators	Porcelain; malleable iron; aluminum; galvanized steel; cement; toughened glass; polymers silicone rubber; fiberglass, aluminum alloy	Air – outdoor	Loss of material due to mechanical wear or corrosion caused by movement of transmission conductors due to significant wind, and wind-driven particles impacting surfaces	AMP XI.E7, "High-Voltage Insulators"	No
~~E~~M	VI.A.LP-28	3.6-1, 003	High-voltage electrical insulators	Porcelain; malleable iron; aluminum; galvanized steel; cement; toughened glass; polymers silicone rubber; fiberglass, aluminum alloy	Air – outdoor	Reduced electrical insulation resistance due to presence of cracks, foreign debris, salt, dust, cooling tower plume, ~~or~~ industrial effluent contamination, or peeling of silicone rubber sleeves for polymer insulators	AMP XI.E7, "High-Voltage Insulators"	No

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New, Modified, Deleted, Edited Item	**Item**	**SRP Item (Table, ID)**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/Mechanism**	**Aging Management Program (AMP)/TLAA**	**Further Evaluation**
E	VI.A.LP-25	3.6-1, 012	Metal enclosed bus: bus/connections	Various metals used for electrical bus and connections	Air – indoor controlled or uncontrolled, air – outdoor	Increased electrical resistance of connection due to the loosening of bolts caused by thermal cycling and ohmic heating	AMP XI.E4, "Metal Enclosed Bus"	No
E	VI.A.LP-26	3.6-1, 013	Metal enclosed bus: electrical insulation; electrical insulators	Porcelain; xenoy; thermo-plastic organic polymers	Air – indoor controlled or uncontrolled, air – outdoor	Reduced electrical insulation resistance due to thermal/thermoxidative degradation of organics/thermoplastics, radiation-induced oxidation, moisture/debris intrusion, ohmic heating	AMP XI.E4, "Metal Enclosed Bus"	No
	VI.A.LP-29	3.6-1, 011	Metal enclosed bus: enclosure assemblies	Elastomer	Air – indoor controlled or uncontrolled, air – outdoor	Surface cracking, crazing, scuffing, dimensional change (e.g. "ballooning" and "necking"), shrinkage, discoloration, hardening, loss of strength due to elastomer degradation	AMP XI.E4, "Metal Enclosed Bus," or AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No
	VI.A.LP-41	3.6-1, 023	Metal enclosed bus: external surface of enclosure assemblies	Galvanized steel; aluminum	Air – indoor controlled or uncontrolled	None	None	No
	VI.A.LP-42	3.6-1, 015	Metal enclosed bus: external surface of enclosure assemblies	Galvanized steel; aluminum	Air – outdoor	Loss of material due to pitting, crevice corrosion	AMP XI.E4, "Metal Enclosed Bus," or AMP XI.S6, "Structures Monitoring"	No

VI Table A	ELECTRICAL COMPONENTS Equipment Not Subject to 10 CFR 50.49 Environmental Qualification Requirements							
New, Modified, Deleted, Edited Item	**Item**	**SRP Item (Table, ID)**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/Mechanism**	**Aging Management Program (AMP)/TLAA**	**Further Evaluation**
	VI.A.LP-44	3.6-1, 024	Metal enclosed bus: external surface of enclosure assemblies	Steel	Air – indoor controlled	None	None	No
	VI.A.LP-43	3.6-1, 014	Metal enclosed bus: external surface of enclosure assemblies	Steel	Air – indoor uncontrolled, air – outdoor	Loss of material due to general, pitting, crevice corrosion	AMP XI.E4, "Metal Enclosed Bus," or AMP XI.S6, "Structures Monitoring"	No
M	VI.A.LP-39	3.6-1, 006	Switchyard bus and connections	Aluminum; copper; bronze; stainless steel; galvanized steel	Air – outdoor	Loss of material due to wind-induced abrasion; Increased resistance of connection due to oxidation or loss of pre-load	A plant-specific aging management program is to be evaluated	Yes
M	VI.A.LP-46	3.6-1, 021	Transmission conductors	Aluminum	Air – outdoor	Loss of conductor strength due to corrosion	None - for ACAR and All Aluminum Conductor (AAC)	No
M	VI.A.LP-38	3.6-1, 004	Transmission conductors	Aluminum; steel	Air – outdoor	Loss of conductor strength due to corrosion	A plant-specific aging management program is to be evaluated for ACSR	Yes
E	VI.A.LP-47	3.6-1, 007	Transmission conductors	Aluminum; Steel	Air – outdoor	Loss of material due to wind-induced abrasion	A plant-specific aging management program is to be evaluated for AAC, ACAR and ACSR	Yes
E	VI.A.LP-48	3.6-1, 005	Transmission connectors	Aluminum; steel	Air – outdoor	Increased resistance of connection due to oxidation or loss of pre-load	A plant-specific aging management program is to be evaluated	Yes
D	VI.A.L-08							
D	VI.A.L-10							