Entergy Operations, Inc.
River Bend Station
5485 U.S. Highway 61N
St. Francisville, LA 70775
Tel 225-381-4374

William F. Maguire
Site Vice President
River Bend Station

RBG-47828

February 20, 2018

Attn: Document Control Desk
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, MD 20852-2738

SUBJECT: Response to License Renewal Application NRC Request for Additional Information (RAI) Set 8
River Bend Station, Unit 1
Docket No. 50-458
License No. NPF-47

References: 1) Entergy Letter: License Renewal Application (RBG-47735 dated May 25, 2017)

2) NRC email: River Bend Station, Unit 1, Request for Additional Information, Set 8 – RBS License Renewal Application – dated January 22, 2018 (ADAMS Accession No. ML18022A941)

Dear Sir or Madam:

In Reference 1, Entergy Operations, Inc (Entergy) submitted an application for renewal of the Operating License for River Bend Station (RBS) for an additional 20 years beyond the current expiration date. In an email dated January 22, 2018, (Reference 2) the NRC staff made a Request for Additional Information (RAI), needed to complete the license renewal application review. Enclosure 1 provides the responses to the Set 8 RAIs. Enclosure 2 provides voluntary changes to the license renewal application (Reference 1). Enclosure 3 identifies commitments noted in Enclosure 1.

If you require additional information, please contact Mr. Tim Schenk at (225)-381-4177 or tschenk@entergy.com.

In accordance with 10 CFR 50.91(b)(1), Entergy is notifying the State of Louisiana and the State of Texas by transmitting a copy of this letter to the designated State Official.

I declare under penalty of perjury that the foregoing is true and correct. Executed on February 20, 2018.

Sincerely,

Timothy C Trask for William Maguire

WFM/RMC/alc

Enclosure 1: Responses to RAIs Set 8 – River Bend Station
Enclosure 2: Voluntary License Renewal Application Changes – River Bend Station
Enclosure 3: Commitments – River Bend Station

cc: (with Enclosure)

U. S. Nuclear Regulatory Commission
Attn: Emmanuel Sayoc
11555 Rockville Pike
Rockville, MD 20852

cc: (w/o Enclosure)

U. S. Nuclear Regulatory Commission
Attn: Lisa Regner
11555 Rockville Pike
Rockville, MD 20852

U.S. Nuclear Regulatory Commission
Region IV
1600 East Lamar Blvd.
Arlington, TX 76011-4511

NRC Resident Inspector
PO Box 1050
St. Francisville, LA 70775

Central Records Clerk
Public Utility Commission of Texas
1701 N. Congress Ave.
Austin, TX 78711-3326

Department of Environmental Quality
Office of Environmental Compliance
Radiological Emergency Planning and Response Section
Ji Young Wiley
P.O. Box 4312
Baton Rouge, LA 70821-4312

RBF1-18-0016

RBG-47828

Enclosure 1

Responses to Request for Additional Information

Set 8

REQUEST FOR ADDITIONAL INFORMATION
LICENSE RENEWAL APPLICATION
RIVER BEND STATION, UNIT 1 – SET 8
DOCKET NO.: 50-458
CAC NO.: MF9757
Office of Nuclear Reactor Regulation
Division of Materials and License Renewal

Question
RAI 3.3.2.1.Y-1 (TRP 75, Copper Alloy)

Background
LRA Table 3.2.2-3, "Residual Heat Removal System," states that loss of material for copper alloy heat exchanger tubes externally exposed to treated water will be managed using the Water Chemistry Control and One Time Inspection programs. The program description in LRA Section B.1.32, "One Time Inspection," program states that, "[e]xamination techniques will be established NDE methods with a demonstrated history of effectiveness in detecting the aging effect of concern, including visual, ultrasonic, and surface techniques."

Issue
Because access to the external surfaces of heat exchanger tubes is typically very limited due to tube spacing, tube supports, backside of tubes, etc., it is unclear to the staff what examination technique will be used to manage loss of material for the copper alloy tubes exposed to treated water. In addition, given the reference to "established NDE methods," it is not clear whether the list of techniques are examples or the only techniques that will be used.

Request
1. State which NDE technique will be used to manage loss of material for the copper alloy heat exchanger tubes.

2. If the technique is not capable of examining the external surfaces of the tube, state the basis for the acceptability of its use.

3. If the visual technique will be used, state configuration details such as tube spacing, distance between rows, and access points for visual inspection.

4. If plant specific procedures do not already cite the inspection technique, what changes will be incorporated into the license renewal application?

Response
1. The line item for copper alloy heat exchanger tubes externally exposed to treated water in LRA Table 3.2.2-3, "Residual Heat Removal System," applies to the residual heat removal heat exchangers. Eddy current testing (ECT) is performed on the residual heat removal (RHR) heat exchangers.

2. ECT is capable of examining the external surface of the tube.

3. Visual inspection will not be utilized as the inspection technique for the RHR heat exchanger tube external surfaces. Therefore, tube spacing, distance between rows, and access points are not necessary.

4. ECT of the RHR heat exchangers is performed in accordance with existing plant procedures. No changes are necessary in the license renewal application.

Question
RAI 3.3.2.1.Y-2 (TRP 75 Copper Alloy)

Background
LRA Table 3.3.2-3, "Service Water System," states that loss of material for copper alloy heat exchanger tubes externally exposed to condensation will be managed for using the External Surfaces Monitoring program. The program description in LRA Section B.1.17, "External Surfaces Monitoring," program states that, "[p]eriodic visual inspection of external surfaces for evidence of loss of material..." will be conducted.

Issue
Because access to the external surfaces of heat exchanger tubes is typically very limited, it is unclear to the staff whether a visual inspection of the tubes' external surfaces can be reasonably expected to detect loss of material.

Request
1. State the basis for why visual examinations will be capable of examining all of the external surfaces of the tube. Alternatively, provide an inspection technique that is capable of examining heat exchanger tubes in order to detect loss of material due to general, pitting and crevice corrosion (e.g., eddy current).

2. State configuration details such as tube spacing, distance between rows, and access points for visual inspection.

3. If an alternative inspection technique is proposed and plant specific procedures do not already cite this inspection technique, what changes will be incorporated into the license renewal application?

Response
1. The line item for copper alloy heat exchanger tubes externally exposed to condensation in LRA Table 3.3.2-3, "Service Water System," applies to the main alternator cooler. Operating experience review did not identify any failures or events involving loss of material of copper alloy heat exchanger tubes in an external environment of condensation. Furthermore, NUREG-2191, "Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report," does not include loss of material as an aging effect requiring management (AERM) for copper alloy heat exchanger tubes externally exposed to condensation. Because loss of material has not been observed and NUREG-2191 acknowledges loss of material of copper alloy heat exchanger tubes externally exposed to condensation is not an AERM for long-term operation, loss of material is removed as an AERM for copper alloy heat exchanger tubes externally exposed to condensation in LRA Table 3.3.2-3.

2. Configuration details such as tube spacing, distance between rows, and access points for visual inspection of tube external surfaces are not required because loss of material for the tube external surfaces is not an AERM. Consequently, this data is not provided.

3. No inspection technique is proposed because loss of material for the tube external surfaces is not an AERM.

Changes to LRA Table 3.3.2-3 follow with deletions lined through.

Table 3.3.2-3
Service Water System
Summary of Aging Management Evaluation

Table 3.3.2-3: Service Water System								
Component Type	**Intended Function**	**Material**	**Environment**	**Aging Effect Requiring Management**	**Aging Management Programs**	**NUREG-1801 Item**	**Table 1 Item**	**Notes**
Heat exchanger (tubes)	Pressure boundary	Copper alloy	Condensation (ext)	Loss of material	External Surfaces Monitoring	VII.F1.AP-109	3.3.1-79	C

Question
RAI 3.3.2.1.Y-3 (TRP 75 Copper Alloy)

Background
LRA Tables 3.3.2-12 and 3.3.2-13, "Control Building HVAC System," and "Miscellaneous HVAC System," respectively states that loss of material for copper alloy heat exchanger tubes externally exposed to condensation will be managed using the Internal Surfaces in Miscellaneous Piping and Ducting Components program. The program description in LRA Section B.1.25, "Internal Surfaces in Miscellaneous Piping and Ducting Components" program states that, "[v]isual inspection will be used to detect evidence of loss of material."

Issue
Because access to the external surfaces of heat exchanger tubes is typically very limited, it is unclear to the staff whether a visual inspection of the tubes' external surfaces can be reasonably expected to detect loss of material.

Request
1. State the basis for why visual examinations will be capable of examining the external surfaces of the tube. Alternatively, provide an inspection technique that is capable of examining heat exchanger tubes in order to detect loss of material due to general, pitting and crevice corrosion (e.g., eddy current).

2. State configuration details such as tube spacing, distance between rows, and access points for visual inspection.

3. If an alternative inspection technique is proposed and plant specific procedures do not already cite this inspection technique, what changes will be incorporated into the license renewal application?

Response
1. The line items for copper alloy heat exchanger tubes externally exposed to condensation in LRA Table 3.3.2-12, "Control Building HVAC System," and Table 3.3.2-13, "Miscellaneous HVAC System," apply to 23 air handling units. Operating experience review did not identify any failures or events involving loss of material of copper alloy heat exchanger tubes in an external environment of condensation. Visual exams conducted in accordance with the Internal Surfaces in Miscellaneous Piping and Ducting Components program on air handling unit tubes can detect flow blockage, foreign debris, damaged fins, and discoloration that may be evidence of loss of material. However, loss of material of these tubes has not been observed. Furthermore, NUREG-2191, "Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report," does not include loss of material as an aging effect requiring management (AERM) for copper alloy heat exchanger tubes externally exposed to condensation. Because loss of material has not been observed and NUREG-2191 acknowledges loss of material of copper alloy heat exchanger tubes is not an AERM for long term operation, loss of material is removed as an AERM for copper alloy heat exchanger tubes externally exposed to condensation in LRA Tables 3.3.2-12 and 3.3.2-13.

2. Configuration details such as tube spacing, distance between rows, and access points for visual inspection of tube external surfaces are not required because loss of material for the tube external surfaces is not an AERM. Consequently, this data is not provided.

3. No inspection technique is proposed because loss of material for the tube external surfaces is not an AERM.

Changes to LRA Table 3.3.2-12 and Table 3.3.2-13 follow with deletions lined through.

Table 3.3.2-12
Control Building HVAC System
Summary of Aging Management Evaluation

Table 3.3.2-12: Control Building HVAC System								
Component Type	**Intended Function**	**Material**	**Environment**	**Aging Effect Requiring Management**	**Aging Management Program**	**NUREG-1801 Item**	**Table 1 Item**	**Notes**
~~Heat exchanger (tubes)~~	~~Pressure boundary~~	~~Copper alloy~~	~~Condensation (ext)~~	~~Loss of material~~	~~Internal Surfaces in Miscellaneous Piping and Ducting Components~~	~~VII.G.AP-143~~	~~3.3.1-89~~	~~C, 306~~

Table 3.3.2-13
Miscellaneous HVAC System
Summary of Aging Management Evaluation

Table 3.3.2-13: Miscellaneous HVAC Systems								
Component Type	**Intended Function**	**Material**	**Environment**	**Aging Effect Requiring Management**	**Aging Management Program**	**NUREG-1801 Item**	**Table 1 Item**	**Notes**
~~Heat exchanger (tubes)~~	~~Pressure boundary~~	~~Copper alloy~~	~~Condensation (ext)~~	~~Loss of material~~	~~Internal Surfaces in Miscellaneous Piping and Ducting Components~~	~~VII.G.AP-143~~	~~3.3.1-89~~	~~C, 306~~

Question
RAI 3.5.1.27-1 (TRP 102 Structural Fatigue)

Background
For aging management of BWR containment structures penetration sleeves and the suppression pool liner, the GALL Report recommends that either (1) cracking due to cyclic loading be managed by the GALL Report AMPs XI.S1, "ASME Section XI, Subsection IWE," and XI.S4, "10 CFR Part 50, Appendix J," if a CLB fatigue analysis does not exist (GALL Report items II.B4.CP-37 and II.B2.1.CP-107); or (2) if a CLB fatigue analysis exists, the cumulative fatigue damage needs to be evaluated as a time limited aging analysis (TLAA) in accordance with 10 CFR 54.21(c) (GALL Report items II.B4.C-13 and II.B2.1.C-45).

Issue
LRA Table 3.5.1, item number 3.5.1-27 states, in part, that the CLB at River Bend Station (RBS) contains a fatigue analysis associated with the penetration sleeves and the suppression pool liner and therefore the aging effect of cracking due to cyclic loading is addressed under AMR item 3.5.1-9. LRA Table 3.5.1 item 3.5.1 9 addresses the aging effect of cumulative fatigue damage due to fatigue for components only when a CLB fatigue analysis exists. However, for electrical penetrations, LRA Section 4.6 states that "electrical penetrations were evaluated, and stresses were found to be so low that fatigue analysis was not required." During its review of site documentation a statement similar to that made in LRA Section 4.6 for the electrical penetrations was also found in document RBS EP 15 00005, "TLAA-Mechanical Fatigue," Revision 0. For the suppression pool liner, a review of LRA Section 4.6 did not identify any TLAA disposition for this component. Based on its review of the LRA, audit supporting documentation, and RBS USAR, the staff found no evidence that a fatigue analysis for the electrical penetration sleeves and suppression pool liner is contained in RBS CLB or addressed as a TLAA in the LRA. Contrary to the GALL Report recommendation that cracking due to cyclic loading be managed by GALL Report AMP XI.S1 or XI.S4 if no CLB fatigue analysis exists, the applicant did not propose to manage this aging effect and did not demonstrate that a CLB fatigue analysis exists. Therefore, it is not clear how the applicant is addressing the aging effect of cracking due to cyclic loading in electrical penetration sleeves and the suppression pool liner consistent with the GALL Report recommendation. Absent consistency with the GALL Report recommendations, the SRP-LR states that additional information is needed from the applicant to describe and demonstrate that its proposed method will be adequate to manage the aging effects.

Request
If the RBS CLB contains a fatigue analysis for the electrical penetration sleeves and suppression pool liner, state the respective TLAA dispositions for these components in accordance with 10 CFR 54.21(c). If there is no CLB fatigue analysis for these components, clarify if the associated aging effects will be managed by the GALL Report AMPs XI.S1 and XI.S4. If the GALL Report recommendations will not be followed, describe the proposed method to manage the aging effect of cracking due to cyclic loading for the electrical penetration sleeves and suppression pool liner, and provide the technical basis for concluding that the proposed method is adequate to manage the associated aging effect so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, in accordance with 10 CFR 54.21(a)(3).

Response
The RBS electrical penetrations are used for the passage of electrical cables and instrumentation leads through the containment. These penetrations are schedule 80 pipe with a flange for mounting the factory-sealed canister. The loadings from the weight of the wires and cables are very low. River Bend Station (RBS) calculations concluded that the maximum calculated stress was much less than

the allowable stress and therefore, fatigue analyses were not necessary. Because calculations show that electrical penetrations are not subject to cyclic loading, cracking due to cyclic loading for the electrical penetration sleeves is not an aging effect requiring management. However, these components were evaluated for loss of material, which is managed by the Containment Inservice Inspection-IWE and the Containment Leak Rate programs, consistent with NUREG-1801.

The portions of the suppression pool that are part of the primary containment boundary are the outer wall and the floor liner. The suppression pool outer wall is formed by the lower part of the cylindrical portion of the steel containment vessel (SCV). This bottom portion of the containment vessel cylinder is backed by structural concrete and a metal fatigue analysis was not necessary for this composite structure. The floor of the suppression pool is a portion of the containment basemat liner. The response to RAI 4.6-1, Request 2, discusses the evaluation of the fatigue TLAA for the basemat liner and provides clarification that was added to license renewal application (LRA) Section A.2.4 to address the evaluation. LRA Table 3.5.2-1 component type "Steel elements (accessible areas): liner; liner anchors; integral attachments (steel containment vessel, floor and suppression pool outer wall liner)" identifies that there is a TLAA to address the effects of aging due to fatigue on the suppression pool liner.

For clarification LRA Tables 2.4-1 and 3.5.2-1 are revised to explicitly identify electrical penetrations and to explicitly credit the Containment Inservice Inspection-IWE and the Containment Leak Rate programs for managing loss of material on electrical penetrations.

Changes to the LRA follow with additions underlined.

Table 2.4-1
Reactor Building
Components Subject to Aging Management Review

Component	**Intended Function**
Steel and Other Metals	
Cranes: rails and structural girders	Support for Criterion (a)(1) equipment Support for Criterion (a)(2) equipment
Cranes: structural girders	Support for Criterion (a)(1) equipment Support for Criterion (a)(2) equipment
<u>Electrical penetrations: sleeves</u>	<u>Enclosure protection</u> <u>Pressure boundary</u> <u>Support for Criterion (a)(1) equipment</u>

Table 3.5.2-1: Reactor Building

Structure and/or Component or Commodity	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Program	NUREG-1801 Item	Table 1 Item	Notes
Electrical penetrations: sleeves	EN, PB, SSR	Carbon steel	Air-indoor uncontrolled	Loss of material	CII-IWE Containment leak rate	II.B3.2.CP-35	3.5.1-35	A

Question

RAI 3.6.2.2.2-1 (TRP 80 High Voltage Insulators)
LRA 3.6.2.2.2 Degradation of Insulator Quality due to Presence of Any Salt Deposits and Surface Contamination, and Loss of Material due to Mechanical Wear

Background
Section 3.6.2.2.2 of SRP LR, "Reduced Insulation Resistance due to Presence of Any Salt Deposits and Surface Contamination, and Loss of Material due to Mechanical Wear Caused by Wind Blowing on Transmission Conductors" states that: "Loss of material due to mechanical wear caused by wind blowing on transmission conductors could occur in high voltage insulators. The GALL Report recommends further evaluation of a plant specific AMP to ensure that this aging effect is adequately managed." The GALL report also recommends further evaluation of plant-specific AMP for potential salt deposits and surface contamination.

In LRA 3.6.2.2.2, the applicant references SRP-LR for further evaluation of the above aging mechanisms and effects for high-voltage insulators. Table 3.6.1, line item numbers 3.6.1-2 and 3.6.1-3 identify the component as: "High voltage insulators composed of porcelain, malleable iron, aluminum, galvanized steel and cement." The corresponding items in Table 3.6.2 of the LRA identify the material as: "Porcelain, galvanized metal and cement."

During the audit, the staff noted that in-scope high-voltage insulators on the 230 kV transmission lines are constructed of polymer material rather than the porcelain material listed in LRA Table 3.6.1 and Table 3.6.2. The applicant stated that the porcelain insulators had recently been replaced with new insulators made of polymeric material. The actual material (polymer) used in construction of the existing in-scope high-voltage insulators are not identified in the applicant's LRA.

The applicant's Table 3.6.2 items corresponding to 3.6.1-2 and 3.6.1-3 cite generic note I, "Aging effect in NUREG-1801 for this component, material and environment combination is not applicable." This generic note is appropriate for instances where the material used at the plant are the same as those listed in GALL.

Issue

- The staff noted a discrepancy between LRA Table 3.6.1 and Table 3.6.2 in describing the material used for high voltage insulators. Table 3.6.2 of the LRA is inconsistent with Table 3.6.1 in that it has omitted malleable iron and aluminum in the list of material that make up this component. It is not clear whether this discrepancy is based on a plant specific evaluation which has determined a lack of such material for high-voltage insulators at RBS or a result of inadvertent omission.

- The material listed in the applicant's LRA Table 3.6.1 and Table 3.6.2 is inconsistent with the actual material used for RBS high-voltage insulators. Polymeric material on the existing components in RBS is not included and has not been evaluated in GALL. The applicant's LRA does not address this inconsistency with GALL and does not provide a further evaluation discussion of the operating experience and aging management requirements of polymeric material used in RBS.

- The applicant's citing of generic note I, "Aging effect in NUREG-1801 for this component, material and environment combination is not applicable," is not appropriate for high-voltage insulators that are constructed of material not included in GALL.

Request

1. Clarify the discrepancy between LRA Table 3.6.1 items 3.6.1-2 and 3.6.1-3 with the two corresponding Table 3.6.2 components that omitted malleable iron and aluminum from the material listed for high-voltage insulators.

2. Justify why the actual material used for high-voltage insulators is not listed in the LRA, or revise the LRA to include polymeric material. Provide a discussion of operating experience, surface buildup of contaminations, aging studies, and any site-specific aging management program needed to ensure that the aging effects for these components composed of polymers will be adequately managed. Describe what parameters will be monitored or inspected to detect the AERM and how the frequency of inspection will be established. If no program will be used, justify why loss of material, deposits, and surface contamination are not applicable for these polymeric material exposed to outdoor air.

3. Revise LRA Table 3.6.2, "Discussion" column to reflect the appropriate evaluation of the high-voltage insulation material that is not in GALL.

Response

Part 1

With the exception of the "discussion" column, LRA Table 3.6.1 is taken verbatim from NUREG-1800, Table 3.6-1. The apparent discrepancy reflects the results of a plant-specific evaluation that determined the specific material for high-voltage insulators at the River Bend Station (RBS). As discussed below, LRA Table 3.6.2 addresses site-specific materials for RBS.

The materials for RBS porcelain high-voltage insulators (station post, strain and suspension applications) are porcelain, metal, and cement. Metal includes the metal parts of an insulator including the cap (covers both ends of the porcelain on a station post insulator and just one end of the porcelain on a strain or suspension insulator) and the pin (connects the bottom of one strain or suspension insulator to the top or cap of another strain or suspension insulator to form a string). A stainless steel clip is used to hold the pin of one insulator in the cap of the next insulator to form a string. The caps and pins are constructed of various galvanized metals such as malleable iron, ductile iron and drop forged steel.

Therefore, the metals identified for the RBS porcelain high-voltage insulators are stainless steel and various galvanized metals such as malleable iron, ductile iron and drop forged steel. The materials listed in Table 3.6-1 of NUREG-1800 and in LRA Table 3.6.1, Item 3.6.1-6, bound the materials used at RBS for the porcelain high-voltage insulators commodity with the exception of stainless steel. NUREG-1800 does not include stainless steel for the high-voltage insulators in items 2 and 3 of Table 3.6-1. Item 6 of Table 3.6-1 does include stainless steel for switchyard bus and connections. In the LRA Table 3.6.2 entry for switchyard bus and connections, which references Item 6 of LRA Table 3.6.1, the term "steel alloy" was intended to include stainless steel. Because stainless steel is a corrosion-resistant material in an air environment, the conclusion in LRA Section 3.6.2.2.3 is that there are no aging effects requiring management for RBS switchyard bus, which includes stainless steel. Stainless steel also has no aging effects requiring management in the high-voltage insulator application.

The RBS materials listed in LRA Table 3.6.2 for porcelain high-voltage insulators are porcelain, galvanized metal, and cement. No changes are necessary for LRA Table 3.6.2 or Table 3.6.1, Item 3.6.1-6 for malleable iron and aluminum; however, LRA Table 3.6.2 will be changed to add steel and stainless steel for the two line items for the porcelain high-voltage insulators.

Part 2

As stated in LRA section 2.5, LRA Drawing LRA-EE-001A depicts the electrical interconnection between RBS and the offsite transmission network. Highlighted portions of LRA-EE-001 identify major components or commodities associated with the restoration of off-site power following a station blackout (SBO). The components in the SBO recovery path are subject to aging management review.

The high-voltage insulators on the transmission conductor towers from the RBS RSS1 transformer yard to the Fancy Point 230kV yard were replaced with polymer insulators in March 2008. The RSS1 transformer yard insulators are still porcelain insulators. The high-voltage insulators on the transmission conductor towers from the RBS RSS2 transformer yard to the Fancy Point 230kV yard were replaced with polymer insulators in January 2008. The RSS2 transformer yard insulators are still porcelain insulators.

High-voltage insulators for the SBO recovery paths are subject to aging management review. Polymer and porcelain high-voltage insulators are used in the SBO recovery paths. Polymer high-voltage insulators are not addressed in NUREG-1801.

<u>LRA Polymer Insulator Materials</u>

The RBS polymer high-voltage insulators and connection hardware have the following materials: fiberglass, silicone rubber, aluminum and aluminum alloy, steel and steel alloys, galvanized metal (galvanized ductile iron, galvanized forged steel, steel hot dip galvanized). The RBS LRA will be changed to add a new line to LRA Table 3.6.2 for high-voltage insulators – polymer and to add these materials to LRA Section 3.6.2.1.

<u>Operating Experience</u>

The Electrical Power Research Institute (EPRI) document 1007752 provides a history of polymer insulator development. This EPRI document refers to EPRI's non-ceramic insulator (NCI) failure database. NCI may also be referred to as polymer, polymeric, or composite insulators. The database includes detailed information on individual failures and is updated as failures are reported. Information on failures as far back as the 1970s is included in the database. As of September 2002, EPRI had entered information on 161 failures. With four exceptions, all of the failures were reported by North American utilities. Of the 161 failures, 130 occurred in North America. An additional 46 international failures were added from an IEEE Task Force Report. The total identified number of failures worldwide is a little more than 200. In addition to failure information, some manufacturers also provided information on the number of units sold. Based on this information the average failure rate for all the manufacturers that provided sales information was 1 per 65,500 units sold. Apart from one manufacturer that experienced no failures, the individual manufacturer failure rates varied from 1 per 65,000 to 1 per 31,000 units sold.

As of the end of December 2017, EPRI's polymer insulator database indicates that there have been approximately 300 total failures reported. This is an increase of approximately 100 total failures from the 2002 total of slightly more than 200, which is approximately seven failures per year on average worldwide.

As of 2017, MacLean Power Systems (MPS) stated they have supplied over 6.3 million high-voltage class insulators (suspension, tension, and line post) in the US and around the world. MPS was also marketed as Reliable Power Products prior to 1986. MPS polymer insulators were included in the 2002 EPRI survey of American utilities that utilized polymer insulators. MPS has identified no failures of polymer insulators manufactured since 2001. The MPS polymer insulators used at RBS were installed in 2008 and have experienced no recorded failures.

The extensive operating experience in transmission and distribution systems demonstrates that polymer insulators are reliable replacements for porcelain insulators and consistently operate with a long service life with little or no maintenance.

Surface Buildup of Contamination

Contamination flashovers account for less than 5% of polymer insulator failures. Laboratory tests and field installation experience have shown that polymer insulators exhibit resistance to contamination flashovers that is superior to that of ceramic insulators. One of the specific advantages of polymer insulators over ceramic insulators is the superior contamination performance. This is attributed both to the difference in the wettability of the surface materials and the differences in geometry. The contamination performance of polymer insulators is dependent on both the design of the insulator and the material from which the insulator is made. Materials with long-term water repellant characteristics provide a larger margin than those without such characteristics. Flashovers caused by contamination generally occur during drizzle, fog, or high humidity conditions due to a reduction in the surface electrical resistance.

Hydrophobicity, which is one of the important characteristics of polymer insulator technology, is a term used to describe how the surface of the insulation material interacts with water. The surface wetting properties of the silicone rubber material of the RBS polymer insulators may be categorized as hydrophobic. Water contacting hydrophobic surfaces tends to form into beads. Silicone rubber (SR) is naturally hydrophobic, has excellent resistance to UV, and minimizes leakage currents on the surface of the insulator, all of which help polymer insulators perform well in contaminated environments. Silicone rubbers are characterized by having a low surface energy that results in highly hydrophobic surfaces. This property prevents the insulator surface from becoming completely wet, thereby suppressing leakage currents under contaminated conditions. Silicone rubber also has the added benefit of encapsulation of contaminants. If a silicone rubber insulator surface becomes coated with pollutants or contaminants, the lightweight silicone chains in the rubber surface material may impregnate the contaminant layer, making it hydrophobic as well. As a result, contaminant flashovers are unlikely. Consequently, silicone rubber insulators can withstand high levels of contamination.

The RBS polymer high-voltage insulator manufactured by MPS has a concentric extruded seamless sheath of silicone rubber that covers the core rod. The stacked sheds or watersheds are also made of silicone rubber. The Si-O molecular bonds (inorganic backbone of silicone) are very stable in the MPS silicone rubber formulation, making the silicone resistant to UV degradation. In addition to providing protection against ultraviolet radiation, electrical aging, and corona effect, silicone exhibits hydrophobic properties, which provide excellent recovery characteristics to control leakage currents in highly polluted or coastal environments. The MPS silicone rubber formulation has consistently outperformed other silicone formulations in its hydrophobicity, its hydrophobicity recovery rate, and its electrical properties in contaminated environments. The RBS insulators were designed for a very high contamination environment, using an alternating shed pattern to increase the leakage current distance. These MPS polymer insulators have superior design characteristics to the porcelain insulators they replaced and are superior insulators under high-contamination conditions.

Aging Studies

A number of accelerated aging tests have been conducted worldwide to evaluate the long-term performance of polymer insulators. These tests are intended to simulate specific environments around which an aging cycle is developed. The design of the aging cycle is dependent on the primary aging mechanism under consideration. For example, if a highly contaminated environment is being considered, a higher number of pollution events may be included in the cycle. In the case of an aging test simulating a low-contamination environment, the number, or duration, of wetting events may be increased. Also, important when designing an aging cycle is to include rest periods where silicone rubber-based insulators are able to recover their hydrophobicity.

EPRI performed accelerated aging tests on 230 kV polymer high-voltage insulators from 2001 to 2005 to evaluate the long-term performance of composite component applications on transmission systems. The accelerated aging chamber had a computer-controlled environmental system simulating a defined climate by varying temperature, clean fog, salt fog, clean rain, UV radiation, and humidity. The environment selected for the accelerated aging test is a warm temperate climate similar to that of the southeastern United States, and Louisiana is included in the EPRI area for the southeastern United States. Polymer insulators from four manufacturers including MPS were used in the EPRI accelerated aging tests. The aging chamber simulated 28.3 years for these tests of 230 kV polymer high-voltage insulators. One failure was noted out of 41 units at 25 years of aged service, but this was not an MPS-manufactured insulator. Investigators compared the polymer insulators test results to analysis of service-aged polymer insulators and concluded the results were reasonable.

The MPS polymer high-voltage insulators installed on the RBS 230 kV offsite power recovery paths are specifically designed and manufactured to eliminate the failure modes identified by aging studies and operating experience with polymer insulators.

Need for Site Specific Aging Management Program

The aging effects for polymer high-voltage insulators are similar to porcelain high-voltage insulators. The aging effects of reduced insulation resistance due to deposits or surface contamination, and loss of material due to mechanical wear caused by wind blowing on transmission conductors are the same as porcelain high-voltage insulators. Polymer high-voltage insulators have the additional aging effect of reduced insulation resistance due to polymer degradation (e.g. due to thermal or thermoxidative degradation of organics, radiolysis, and photolysis (UV sensitive materials only) of organics; radiation-induced oxidation; moisture intrusion).

The following aging effects for polymer high-voltage insulators are evaluated.

- reduced insulation resistance due to deposits or surface contamination
- loss of material due to mechanical wear caused by wind blowing on transmission conductors
- reduced insulation resistance due to polymer degradation

Loss of Material

As discussed in LRA Section 3.6.2.2.2 for porcelain high-voltage insulators, loss of material due to mechanical wear is a potential aging effect for strain and suspension insulators subject to movement. Although this aging effect is possible, industry experience has shown transmission conductors do not normally swing. When subjected to a substantial wind, movement will subside after a short period. Wear has not been apparent during routine inspections and is not a credible aging effect. The end components and the connection hardware for the polymer high-voltage insulators are the same in design and material as the porcelain high-voltage insulators. Therefore, loss of material (wear) and fatigue that could be caused by transmission conductor vibration or sway are not aging effects requiring management in that they would not cause a loss of intended function if left unmanaged for the period of extended operation.

Deposits and Surface Contamination

As discussed in LRA Section 3.6.2.2.2 for porcelain high-voltage insulators, various airborne materials such as dust, salt and industrial effluents can contaminate insulator surfaces. The buildup of surface contamination is gradual and, in most cases, removed by rainfall. As discussed previously, the silicone rubber of the polymer high-voltage insulator is superior to porcelain. This is the basis for the proven method of coating porcelain insulators with silicone rubber to increase the ability of porcelain to prevent contamination build-up that can cause flashover. As documented for the porcelain insulators, reduced insulation resistance due to surface contamination is not an aging effect requiring management for the polymer high-voltage insulators at RBS in that it would not cause a loss of intended function if left unmanaged for the period of extended operation.

Reduced Insulation Resistance Due to Polymer Degradation

The polymer material for the RBS polymer high-voltage insulators is silicone rubber. Similar to aging effects discussions for electrical cables, silicone rubber is subject to reduced insulation resistance due to polymer degradation from thermal/ thermoxidative degradation of organics, radiolysis, and photolysis (UV sensitive materials only) of organics; radiation induced oxidation; and moisture intrusion. Silicone rubbers are characterized by having a low surface energy that results in highly hydrophobic surfaces, which inhibits moisture accumulation on the insulator surface. The MPS silicone formulation Si-O molecular bonds (inorganic backbone of silicone) are very stable and have bond strengths higher than sunlight, making the silicone resistant to UV degradation. The environment does not support radiation induced oxidation. Silicone rubbers are very resistant to thermal and thermoxidative degradation, based on an 80-year service limiting temperature of 268.9°F (131.6°C). Reduced insulation resistance due to polymer degradation is not an aging effect requiring management for the polymer high-voltage insulators at RBS in that it would not cause a loss of intended function if left unmanaged for the period of extended operation.

Because there are no aging effects requiring management, there are no parameters that will be monitored or inspected to detect aging effects. Loss of material, deposits, and surface contamination are not aging effects requiring management for the RBS polymer insulators as discussed in previous sections.

Part 3
LRA Table 3.6.2 has no "Discussion" column. The discussion column in LRA Table 3.6.1 addresses the comparison of RBS aging management review results to aging management review results documented in NUREG-1801 for the same material and environment combinations. Because polymer insulators are not addressed in NUREG-1801, there is no appropriate line item in Table 3.6.1 against which to compare the RBS aging management review results for polymer insulators. Note F is used in the Notes column in LRA Table 3.6.2 for the new line item for the polymeric material included in the part 2 response to indicate that the material is not in NUREG-1801 for this component.

LRA Table 3.6.1, Items 3.6.1-2 and 3.6.1-3 address high-voltage insulators. The discussion column for both items refers to Section 3.6.2.2.2 for further discussion. LRA Table 3.6.1, Items 3.6.1-2 and 3.6.1-3 are based on NUREG-1800 for porcelain high-voltage insulators. These items are still applicable to the RBS porcelain high-voltage insulators, but they are not applicable to the RBS polymer high-voltage insulators. Therefore, there are no changes to these items.

The changes to LRA Section 3.6.2.1, and Table 3.6.2 follow with additions underlined and deletions lined through.

3.6.2.1 Materials, Environments, Aging Effects Requiring Management, and Aging Management Programs

The following sections list the materials, environments, aging effects requiring management, and aging management programs for electrical and I&C components subject to aging management review. Programs are described in Appendix B. Further details are provided in Table 3.6.2.

Materials

Electrical and I&C components subject to aging management review are constructed of the following materials.

Aluminum <u>and aluminum alloy</u>
Cement
<u>Fiberglass</u>
Galvanized metals
Insulation material – various organic polymers
Porcelain
<u>Silicone rubber</u>
Steel and steel alloys
Various metals used for bus and electrical connections

Table 3.6.2: Electrical and I&C Components

Structure and/or Component or Commodity	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Program	NUREG-1801 Item	Table 1 Item	Notes
High-voltage insulators (high-voltage insulators for SBO recovery)	IN	Porcelain, steel and stainless steel, galvanized metal, cement	Air – outdoor	None	None	VI.A.LP-32 VI.A-10 (LP-11)	3.6.1-2	I
High-voltage insulators (high-voltage insulators for SBO recovery)	IN	Porcelain, steel and stainless steel, galvanized metal, cement	Air – outdoor	None	None	VI.A.LP-28 VI.A-9 (LP-07)	3.6.1-3	I
High-voltage insulators – Polymer (high-voltage insulators for SBO recovery)	IN	Fiberglass, silicone rubber, aluminum and aluminum alloy, steel and galvanized metals	Air – outdoor	None	None	--	--	F

Question
RAI B.1.2-1 (TRP 19 Bolting Integrity)

Background
The "detection of aging effects" program element of GALL Report AMP XI.M18, "Bolting Integrity," recommends periodic visual inspections (at least once per refueling cycle) of closure bolting for signs of leakage to ensure the detection of age related degradation due to loss of material and loss of preload. Through periodic inspection of pressure boundary components for signs of leakage, the program will ensure that age-related degradation of closure bolting is detected and corrected before component leakage becomes excessive.

LRA Section B.2.1, "Bolting Integrity," states that the Bolting Integrity Program is an existing program, with exceptions and enhancements, which will be consistent with GALL Report AMP XI.M18. The LRA credits the Bolting Integrity Program to manage closure bolting on air/gas-filled systems (e.g., compressed air system; combustible gas control system; control building heating, ventilation, and air conditioning (HVAC) system; HVAC-containment cooling system; HVAC-diesel generator system; etc.). Enhancement 3 to the "detection of aging effects" program element states, in part, that the program will be revised to specify visual inspection of a representative sample of closure bolting (bolt heads, nuts, and threads) in air environments.

Issue
It is not clear if the "air environment" referenced in Enhancement 3 applies to closure bolting that is exposed to an external air environment or if it applies to closure bolting exposed to an internal air/gas environment (i.e., air/gas filled systems). In addition, for air/gas filled systems, it is not clear how visual inspections can detect signs of leakage of clear gaseous fluids. Therefore, it is not clear how signs of leakage from air/gas filled systems will be detected to ensure the detection of age related degradation due to loss of material and loss of preload before there is a loss of intended function.

Request
State whether Enhancement 3 applies to systems with an air/gas internal environment (i.e., air/gas-filled systems). For each of the air/gas filled systems with closure bolting in-scope of license renewal, describe the proposed method(s) (including sample size, type, and frequency of inspections as applicable) to detect signs of air/gas leakage on closure bolted connections and provide the basis to demonstrate that such method(s) will ensure the detection of age related degradation due to loss of material and loss of preload before there is a loss of intended function.

Response
Enhancement 3 of the Bolting Integrity Program applies to systems with an air/gas internal environment (i.e., air/gas-filled systems) and to systems with other internal environments.

To augment visual inspections for leakage, the enhancement provides for visual inspection of a representative sample of closure bolting that is removed from bolted closures. The environment that influences the effects of aging on the bolting is the external environment. Therefore, a separate sample of bolt heads, nuts, and threads will be visually inspected from each combination of bolting materials and external environments to which the bolting is exposed, including the bolting materials and bolting environments applicable to systems containing air/gas. Each sample will consist of 20% up to a maximum of 25 fasteners every 10 years. This sample size is consistent with the representative sample size defined in NUREG-1801, Section XI.M32, One-Time Inspection and

Section XI.M38, Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components, as modified by LR-ISG-2012-02, "Aging Management of Internal Surfaces, Fire Water Systems, Atmospheric Storage Tanks, and Corrosion under Insulation." This approach is similar to the sampling approach recommended in Section XI.M18 of NUREG-2191 as an option for submerged closure bolting.

Question

RAI B.1.2-2 (TRP 19 Bolting Integrity)

Background

LRA Section B.1.2, "Bolting Integrity," states that the Bolting Integrity Program is an existing program, with exceptions and enhancements, which will be consistent with GALL Report AMP XI.M18, "Bolting Integrity." The "detection of aging effects" program element of GALL Report AMP XI.M18, "Bolting Integrity," recommends periodic inspections (at least once per refueling cycle) of closure bolting for signs of leakage to ensure the detection of age related degradation due to loss of material and loss of preload. The LRA states an enhancement (Enhancement 1) to the "scope of program" program element to include submerged closure bolting in its program procedures.

The LRA also states in Exception 2 to the "detection of aging effects" program element that "[s]ubmerged pressure retaining bolting will be inspected at least once every 10 years." This is an exception to the GALL Report recommendation that pressure-retaining bolting be inspected at least once every refueling cycle. In its bases for Exception 2 the applicant states in part the following:

- Accessible surfaces of the suppression pool suction strainer submerged stainless steel bolting will be subjected to visual inspection of the bolt heads, nuts, and threaded bolt shank beyond the nut.
- Other submerged pressure-retaining bolting is associated with pumps that are periodically removed and inspected during maintenance and will thus be subject to visual inspections at a sufficient frequency to detect aging effects prior to a loss of intended function.
- Submerged bolting periodically inspected by divers is subject to visual inspection of accessible surfaces of bolting to manage loss of material and divers will also verify that the bolting is hand tight to manage loss of preload.
- All normally submerged pressure-retaining bolting will be inspected at least once every 10 years.

Issue

In its review of Exception 2 related to the "detection of aging effects" program element, the staff noted that the applicant classified its submerged bolting in three categories: (1) suppression pool suction strainer bolting; (2) bolting associated with pumps that are periodically removed and inspected for maintenance; and (3) bolting periodically inspected by divers. The staff has the following concerns associated with Exception 2:

- It is not clear whether all submerged closure bolts related to the pumps removed for maintenance and those inspected by divers will be subject to the periodic inspections described in categories 2 and 3 above, or if a representative sample of the population will be inspected.
- It is not clear what the frequency of the inspections would be for the submerged closure bolts related to the pumps removed for maintenance, and that periodically inspected by divers (categories 2 and 3 above, respectively). For the bolts related to the pumps removed for maintenance, it is not clear whether the program is solely crediting the maintenance activities, or if there will be periodic focused inspections in addition to the visual examination when the pumps are removed for maintenance. For the bolting related to the pumps and that periodically inspected by divers, adequate justification for using a frequency other than the GALL Report recommendation of

once per refueling outage was not provided.

- For the submerged closure bolts related to the suppression pool suction strainer it is not clear how the program will detect loss of preload in a submerged environment through a visual inspection or if additional inspection methods will be available to verify bolt tightness.
- For the pumps removed for maintenance it is not clear if all surfaces of the related bolts (head, nuts, and threads) will be inspected during the maintenance activity.
- The applicant has not provided an enhancement to the program describing the methods and frequency of inspections for the submerged closure bolting.

Based on the concerns listed above it is not clear how the submerged closure bolting will be inspected such that loss of material and loss of preload can be detected prior to a loss of intended function.

Request

1. For the submerged closure bolts related to the pumps periodically removed for maintenance, and that are periodically inspected by divers, state whether periodic inspections will include all submerged bolting or if a sample of the population will be inspected. If the periodic inspections are based on a sample describe and justify the proposed sample.
2. For the submerged closure bolts related to the pumps removed for maintenance, and those periodically inspected by divers, state the frequency of inspection and provide justification.
3. For the submerged closure bolts related to the suppression pool suction strainer state whether the loss of preload aging effect will be detected through a visual inspection or state whether additional inspection methods will be used to verify bolt tightness.
4. For the submerged closure bolts related to the pumps being removed for maintenance, clarify if all surfaces of the closure bolt (head, nuts, and threads) will be inspected during their removal.
5. State and justify whether an enhancement to the program is needed to discuss the aging management of submerged closure bolting.

Response

1. The inspections for the submerged component closure bolts will be conducted when the components are removed from the water. Bolt heads, threads and nuts will be visually inspected if made accessible during the maintenance activity. For each combination of bolting material and environment, a representative sample of closure bolt assemblies will be inspected in each 10-year period of the period of extended operation. The entire closure bolt assembly, including the bolt heads, threads, and nuts as applicable, will be inspected. The proposed sample is statistically representative of the total population for each material and environment combination and is consistent with the recommendations in the Bolting Integrity Program description in the recently issued NUREG-2191, Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report.

For the RBS Bolting Integrity Program, personnel will visually inspect all accessible bolting surfaces of the suppression pool suction strainers. A sampling-based inspection will not be employed for suppression pool suction strainer submerged bolting.

2. For the closure bolts on submerged components other than the suppression pool suction strainers, see the response to Request 1 for frequency and justification. For the suppression pool suction strainer submerged bolting, personnel will perform the visual inspection of accessible bolts at least once every 10 years. This frequency is appropriate because the bolts are fabricated from stainless steel, are subject to a treated water environment, and are either torqued at installation in accordance

with manufacturer specification or the bolts or nuts are lock-wired to prevent loosening. These bolting inspections will include visual inspection of the bolt heads, nuts, and threaded bolt shank, where accessible. The frequency is consistent with ASME Section XI, Table IWB 2500-1, Examination Categories B-G-1 and B-G-2 which specifies visual examination of pressure-retaining bolts at least once each 10-year ISI interval.

3. For the suppression pool suction strainer submerged closure bolts, visual inspection of the bolt heads, nuts, and threaded bolt shank, where accessible, is performed and is appropriate for managing loss of material which could lead to loss of preload. In addition, if divers perform the inspections, the inspectors will physically verify that the bolting is at least hand tight to detect potential loss of preload.

4. For the representative sample of submerged closure bolting, all surfaces of the closure bolt assembly (head, nuts, and threads) will be inspected.

5. The first enhancement to the Bolting Integrity Program states "Revise Bolting Integrity Program procedures to include submerged closure bolting for pressure-retaining components." The enhancement is revised to describe the methods and frequency of inspections.

The second exception provides for the lower inspection frequency for submerged bolting. The second paragraph of the justification is potentially confusing in its reference to the frequency of maintenance activities. As noted in the exception, and in revised Enhancement 1, all accessible suppression pool suction strainer submerged closure bolting will be inspected at least once every 10 years and if divers perform the inspection, bolting that is not removed will be checked manually to verify that it remains at least hand tight. For each combination of other submerged closure bolting material and environment, a representative sample of closure bolt assemblies will be inspected in each 10-year period of the period of extended operation. The second paragraph of the bases for the second exception is removed to eliminate the potential confusion regarding frequency of inspection. For additional clarification, the third paragraph is revised to identify visual inspections and physical manipulation of the suppression pool suction strainers bolted closures, and provide the basis for representative sampling of other submerged bolted closures.

The changes to LRA Sections A.1.2 and B.1.2 follow with additions underlined and deletions lined through.

A.1.2 Bolting Integrity

The Bolting Integrity Program will be enhanced as follows.

- Revise Bolting Integrity Program procedures to include submerged closure bolting for pressure-retaining components. All accessible suppression pool suction strainer submerged closure bolting will be inspected at least once every 10 years and if the inspection is performed by divers, accessible bolting that is not removed will be checked manually to verify that it remains at least hand tight. For each combination of other submerged closure bolting material and environment, a representative sample of closure bolt assemblies will be inspected in each 10-year period of the period of extended operation. Bolt heads, threads, and nuts, if applicable, will be inspected when joints are disassembled. For each material and environment combination, the representative sample will include 20 percent of the population or at least 25 closure bolt assemblies.

- Revise Bolting Integrity Program procedures to volumetrically examine high-strength bolting (regardless of code classification) (i.e., bolting with actual yield strength greater than or equal to 150 ksi) for cracking in accordance with ASME Section XI, Table IWB-2500-1, Examination Category B-G-1.

- Revise Bolting Integrity Program documents to specify visual inspection of a representative sample of closure bolting (bolt heads, nuts, and threads) in air environments. A representative sample will be 20 percent of the population (for each material/environment combination) up to a maximum of 25 fasteners during each 10-year period of the period of extended operation. The inspections will be performed when the bolting is removed to the extent that the bolting threads and bolt heads are accessible for inspections that cannot be performed during visual inspection with the threaded fastener installed.

Enhancements will be implemented prior to the period of extended operation.

B.1.2 BOLTING INTEGRITY

Exceptions to NUREG-1801

The Bolting Integrity Program has the following exceptions.

Element Affected	Exception
4. Detection of Aging Effects	NUREG-1801 recommends periodic inspections of bolting for leakage, loss of preload, and cracking. Opportunistic inspections are performed for buried fire water system bolting in lieu of periodic inspections.[1]
4. Detection of Aging Effects	NUREG-1801 recommends periodic inspection of pressure-retaining bolting for loss of material, loss of preload, and cracking at a frequency of at least once every refueling cycle. Suppression pool suction strainer ~~S~~ submerged pressure-retaining bolting will be inspected at least once every 10 years and if divers perform the inspection, accessible bolting that is not removed will be checked manually to verify that it remains at least hand tight. For other submerged closure bolting, a representative sample of closure bolt assemblies will be inspected in each 10-year period of the period of extended operation.[2]

Bases for Exceptions

1. The Bolting Integrity Program manages loss of preload for buried fire water system bolting using preventive measures implemented before burial, specifically, verifying correct material, checking for uniform gasket compression after assembly, applying protective coating, and applying an appropriate preload. These measures have proven effective in managing loss of preload for buried fire water system bolting. Opportunistic inspection of buried fire water system bolting is performed such as in conjunction with excavations performed for the Buried and Underground Piping and Tanks Inspection Program (Section B.1.4).
2. The visual inspection of accessible surfaces of suppression pool suction strainer submerged bolting at least once every 10 years is appropriate because the bolts are fabricated from stainless steel, are subject to a treated water environment, and are either torqued at installation in accordance with manufacturer specification or have the bolts/nuts lock-wired together. These bolting inspections will include visual inspection of the bolt heads, nuts, and threaded bolt shank beyond the nut, where accessible. The frequency is consistent with ASME Section XI, Table IWB 2500-1, Examination Categories B-G-1 and B-G-2 which specify visual examination of pressure-retaining bolts at least once each 10-year ISI interval.

   ~~Other submerged pressure-retaining bolting is associated with pumps that are periodically removed and inspected during maintenance. Maintenance activities provide for bolting visual inspections at a frequency sufficient to detect aging effects prior to loss of intended function.~~

   For suppression pool suction strainer submerged bolting that is periodically inspected by divers, physically verifying that the bolting is hand tight is effective in managing loss of preload, and visual inspection of accessible bolting surfaces is appropriate for managing loss of material.

   For other submerged closure bolting, the proposed sample is statistically representative of the total population for each material and environment combination and is consistent with the recommendations in the Bolting Integrity Program description in the recently issued NUREG-2191, Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report.

   ~~All normally submerged pressure-retaining bolting will be inspected at least once every 10 years. These measures have proven effective in managing loss of material, cracking, and loss of preload for normally submerged pressure-retaining bolting.~~

Enhancements

The following enhancements will be implemented prior to the period of extended operation.

Element Affected	Enhancement
1. Scope of Program	Revise Bolting Integrity Program procedures to include submerged closure bolting for pressure-retaining components. All accessible suppression pool suction strainer submerged closure bolting will be inspected at least once every 10 years and if divers perform the inspection, accessible closure bolting that is not removed will be checked manually to verify that it remains at least hand tight. For each combination of other submerged closure bolting material and environment, a representative sample of closure bolt assemblies will be inspected in each 10-year period of the period of extended operation. Bolt heads, threads, and nuts, if applicable, will be inspected when joints are disassembled. For each material and environment combination, the representative sample will include 20 percent of the population or at least 25 closure bolt assemblies.
4. Detection of Aging Effects	Revise Bolting Integrity Program procedures to volumetrically examine high-strength bolting (regardless of code classification) (i.e., bolting with actual yield strength greater than or equal to 150 ksi) for cracking in accordance with ASME Section XI, Table IWB-2500-1, Examination Category B-G-1.
4. Detection of Aging Effects	Revise Bolting Integrity Program documents to specify visual inspection of a representative sample of closure bolting (bolt heads, nuts, and threads) in air environments. A representative sample will be 20 percent of the population (for each material/environment combination) up to a maximum of 25 fasteners during each 10-year period of the period of extended operation. The inspections will be performed when the bolting is removed to the extent that the bolting threads and bolt heads are accessible for inspections that cannot be performed during visual inspection with the threaded fastener installed.

Question
RAI B.1.28 1 (TRP 51 Inaccessible Power Cables Not Subject to 10 CFR 50.49 EQ Requirements)
LRA AMP B.1.28, Non-EQ Inaccessible Power Cables (>400V)

Background
In the LRA, the applicant states that B.1.28, "Non-EQ Inaccessible Power Cables (>400V)," is a new condition monitoring program that will be consistent with the program elements in GALL Report AMP XI.E3, "Inaccessible Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements."

The preventive actions element of the GALL Report AMP XI.E3 includes inspection and operational verification of dewatering devices prior to any known or predicted heavy rain or flooding event.

The corrective actions element of the GALL Report AMP XI.E3 includes a statement for evaluation to consider the significance of the test or inspection results, the operability of the component, the reportability of the event, the extent of concern, the potential root causes for not meeting the test or inspection acceptance criteria, the corrective actions required, and the likelihood of occurrence.

Issue
- The applicant's proposed preventive actions element as described in RBS-EP-15-00009 "Aging Management Program Evaluation Results – Electrical" does not include the provisions in GALL Report AMP XI.E3 which calls for inspection and operational verification of dewatering devices prior to known or predicted heavy rain or storms.

- The applicant's proposed corrective actions element as described in RBS-EP-15-00009 "Aging Management Program Evaluation Results – Electrical" does not include the provisions in GALL Report AMP XI.E3 which entails a statement for evaluation to consider the significance of the test or inspection results, the operability of the component, the reportability of the event, the extent of concern, the potential root causes for not meeting the test or inspection acceptance criteria, the corrective actions required, and the likelihood of occurrence.

- Inspection and operational verification of dewatering devices prior to any known or predicted heavy rain or flooding event is not mentioned in the LRA USAR supplement A.1.28 as described in SRP-LR Table 3.0-1, "FSAR Supplement for Aging Management of Applicable Systems."

Request
1. Explain how the proposed preventive actions element of AMP B.1.28, "Non-EQ Inaccessible Power Cables (>400V)" is consistent with GALL Report AMP XI.E3 while missing the provisions for operational verification of dewatering devices prior to known or predicted flooding events.

2. Explain how the proposed corrective actions element of AMP B.1.28, "Non-EQ Inaccessible Power Cables (>400V)" is consistent with GALL Report AMP XI.E3 while missing the provisions for evaluation to consider the significance of the test or inspection results, the operability of the component, the reportability of the event, the extent of concern, the potential root causes for not

meeting the test or inspection acceptance criteria, the corrective actions required, and the likelihood of occurrence.

3. Revise LRA USAR supplement A.1.28 to include inspection and operational verification of dewatering devices prior to any known or predicted heavy rain or flooding event as described in SRP-LR, Table 3.0-1, or explain how the description of the program in LRA USAR supplement A.1.28 is adequate for managing the effects of aging.

Response

Part 1
As indicated in LRA Section B.1.28, the Non-EQ Inaccessible Power Cables (≥ 400 V) Program will be consistent with NUREG-1801, Section XI.E3. Changes to LRA Section B.1.28 program description are made to include the provisions for operational verification of dewatering devices prior to known or predicted heavy rain or flooding events.

Part 2
As indicated in LRA Section B.1.28, the Non-EQ Inaccessible Power Cables (≥ 400 V) Program will be consistent with NUREG-1801, Section XI.E3. The specific statement in NUREG-1801, Section XI.E3, under the corrective actions element is as follows.

> "Corrective actions are taken and an engineering evaluation is performed when the test or inspection acceptance criteria are not met. Such an evaluation considers the significance of the test or inspection results, the operability of the component, the reportability of the event, the extent of the concern, the potential root causes for not meeting the test or inspection acceptance criteria, the corrective actions required, and the likelihood of recurrence."

The site support document, Aging Management Program Evaluation Results – Electrical, states the following for the corrective actions element.

> "An engineering evaluation will be performed as part of the corrective actions when the test acceptance criteria are not met in order to ensure that the intended functions of the electrical cables can be maintained consistent with the current licensing basis."

The NUREG-1801 statement in the sentence that starts with, "such an evaluation," is describing the corrective action program; not the Non-EQ Inaccessible Power Cables (≥ 400 V) Program. In LRA Section B.0.3, the RBS LRA states that the corrective action controls of the RBS quality assurance (QA) program (10 CFR Part 50, Appendix B) are applicable to all aging management programs and activities through the period of extended operation.

The NUREG-1801 statement that discusses elements of an engineering evaluation under the corrective action program is not the controlling statement. The controlling statement is that RBS will perform an engineering evaluation as part of the corrective actions when the test acceptance criteria are not met, which will be controlled by the corrective action program not the Non-EQ Inaccessible Power Cables (≥ 400 V) Program. No change is needed for this item.

Part 3
RBS LRA Section A.1.28 is revised to include inspection and operational verification of dewatering devices prior to any known or predicted heavy rain or flooding event. This change is also added to

LRA Section B.1.28.

The changes to LRA Sections A.1.28 and B.1.28 follow with additions underlined.

A.1.28 Non-EQ Inaccessible Power Cables (≥ 400 V)
The Non-EQ Inaccessible Power Cables (≥ 400 V) Program manages the aging effect of reduced insulation resistance on the inaccessible power cable systems (≥ 400 V) that have a license renewal intended function. The program includes periodic actions to minimize inaccessible cable exposure to significant moisture. Significant moisture is defined as periodic exposures to moisture that last more than a few days (e.g., cable wetting or submergence in water). In this program, inaccessible power cables (≥ 400 V) exposed to significant moisture are tested at least once every six years to provide an indication of the condition of the cable insulation properties. Test frequencies are adjusted based on test results and operating experience. The specific type of test performed is a proven test for detecting deterioration of the cable insulation. A proven, commercially available test will be used for detecting deterioration of the insulation system due to wetting or submergence for inaccessible power cables (≥ 400 V) included in this program, such as dielectric loss (dissipation factor/power factor), AC voltage withstand, partial discharge, step voltage, time domain reflectometry, insulation resistance and polarization index, line resonance analysis, or other testing that is state-of-the-art at the time the tests are performed.

The program includes periodic inspections for water accumulation in manholes at least once every year (annually). In addition to the periodic manhole inspections, manhole inspections for water after event-driven occurrences, such as flooding, will be performed. The inspections will include direct observation that cables are not wetted or submerged, that cables, splices and cable support structures are intact, and dewatering systems (i.e., sump pumps) and associated alarms, if applicable, operate properly. Inspection frequency will be increased as necessary based on evaluation of inspection results. <u>In addition to the periodic manhole inspections, operation of dewatering systems will be inspected, and operation verified prior to any known or predicted heavy rain or flooding events.</u>

This program will be implemented prior to the period of extended operation.

B.1.28 NON-EQ INACCESSIBLE POWER CABLES (≥ 400 V)

<u>Program Description</u>
The Non-EQ Inaccessible Power Cables (≥ 400 V) Program is a new condition monitoring program that will manage the aging effect of reduced insulation resistance on inaccessible power cables (≥ 400 V) that have a license renewal intended function. The cables included in this program are routed underground.

The Non-EQ Inaccessible Power Cables (≥ 400 V) Program will include periodic actions to minimize inaccessible cable exposure to significant moisture. Significant moisture is defined as periodic exposures to moisture that last more than a few days (e.g., cable wetting or submergence in water). In this program, inaccessible power cables (≥ 400 V) exposed to significant moisture will be tested at least once every six years to provide an indication of the condition of the cable insulation properties. Test frequencies are adjusted based on test results and operating experience. The specific type of test performed is a proven test for detecting deterioration of the cable insulation.

The program will include periodic inspections for water accumulation in manholes at least once every year (annually). In addition to the periodic manhole inspections, manhole inspections for water after event-driven occurrences, such as flooding, will be performed. The inspections will include direct observation that cables are not wetted or submerged; that cables, splices and cable support structures are intact; and dewatering systems (i.e., sump pumps) and associated alarms, if applicable, operate properly. Inspection frequency will be increased as necessary based on evaluation of inspection results. In addition to the periodic manhole inspections, operation of dewatering systems will be inspected, and operation verified prior to any known or predicted heavy rain or flooding events.

A proven, commercially available test will be used for detecting deterioration of the insulation system due to wetting or submergence for inaccessible power cables (≥ 400 V) included in this program, such as dielectric loss (dissipation factor/power factor), AC voltage withstand, partial discharge, step voltage, time domain reflectometry, insulation resistance and polarization index, line resonance analysis, or other testing that is state-of-the-art at the time the tests are performed.

This program will be implemented prior to the period of extended operation.

Question
RAI B.1.29-1 (TRP 49 Insulation Material for Electrical Cables – Connections Not Subject to 10 CFR 50.49 EQ Requirements)

LRA B.1.29 Non-EQ Insulated Cables and Connections

Background
Parameters monitored/inspected element of the GALL Report AMP XI.E1 recommends to inspect all accessible electrical cables and connections installed in adverse localized environments. The applicant's proposed corresponding program element as described in RBS-EP-15-00009 "Aging Management Program Evaluation Results – Electrical" states that samples of accessible cable will represent, with reasonable assurance, all cables and connections in adverse localized environments.

Corrective action element of the GALL Report AMP XI.E1 recommends that when an unacceptable condition or situation is identified, a determination is made as to whether the same condition or situation is applicable to inaccessible cables or connections. The applicant's proposed corresponding program element as described in RBS-EP-15-00009 "Aging Management Program Evaluation Results – Electrical" states that when an adverse localized environment is identified for the insulation material of a cable or connection, a determination will be made as to whether the same condition or situation is applicable to other accessible or inaccessible cables or connections.

In LRA A.1.29, the applicant states: "The program sample consists of all accessible cables and connections in adverse localized environment. This program sample of accessible cables will represent, with reasonable assurance, all cables and connections in adverse localized environments."

Issue
- The applicant's sample inspection of accessible cables and connections is inconsistent with GALL AMP XI.E1 which recommends to inspect all accessible cables and connections in adverse localized environment.

- The applicant's proposed corrective action program element as described in RBS-EP-15-00009 appears to inspect a sample of accessible cables and connections in adverse localized environment, and when an unacceptable condition or situation is identified, a determination is made to whether the same condition or situation is applicable to other accessible and inaccessible cables and connections in the adverse localized environment. The corresponding GALL Report XI.E1 recommends inspecting all accessible cables and connections in adverse localized environment. When an unacceptable condition or situation is identified for a cable or connection in the inspection, a determination is made as to whether the same condition or situation is applicable to inaccessible cables and connections. As such the applicant program appears not to be consistent with GALL program. Specifically, the applicant's sample inspection of accessible vs. inspection of all accessible cables and connections recommended by the GALL Report in adverse localized environment.

- It appears that sampling of accessible cables and connections in adverse localized environments as described in the applicant's LRA USAR supplement is not consistent with the description of program in SRP-LR. Table 3.0-1 of SRP-LR states that the program consists of all accessible electrical cable and connections installed in adverse localized environments to be visually inspected.

Request

1. Explain how the sample inspection in parameters monitored/inspected element as described in RBS-EP-15-00009 is consistent with GALL, or provide justification of how the sample inspection of accessible cables and connections is adequate to manage the aging effects of all cables and connections in adverse localized environment.

2. Explain how the corrective actions element as described in RBS-EP-15-00009 is consistent with GALL, or provide justification of how the proposed corrective actions are adequate to manage the aging effects of all cables and connections in adverse localized environment.

3. Explain how the LRA USAR supplement A.1.29 description is consistent with Table 3.0-1 of the SRP-LR, or explain how the same inspection in LRA USAR supplement A.1.29 is adequate for managing the effects of aging as described in SRP-LR, Table 3.0-1.

Response

Part 1

As stated in the background of this RAI, and in NUREG-1801, Section XI.E1, the parameters monitored/inspected element recommends inspection of all accessible electrical cables and connections installed in adverse localized environments. In fact, "all *accessible* electrical cables and connections installed in adverse localized environments" is a sample of the total population of all *accessible and inaccessible* electrical cables and connections installed in adverse localized environments, plus those not installed in adverse localized environments, which are in the scope of this program. Therefore, NUREG-1801, Section XI.E1 uses a sampling approach where all *accessible* cables in adverse localized environments represent all cables whether accessible or not.

The statement made in the site support document, Aging Management Program Evaluation Results – Electrical, for the Non-EQ Insulated Cables and Connections Program, in the parameters monitored/inspected element is as follows.

> "Accessible electrical cables and connections installed in adverse localized environments, which constitute a representative sample of the insulated cables and connections within the scope of license renewal, will be visually inspected for cable and connection jacket and connection insulation surface anomalies indicating signs of reduced insulation resistance. This program sample of accessible cables will represent, with reasonable assurance, all cables and connections in the adverse localized environment."

The program description in LRA section B.1.29 is changed to clarify that program scope is consistent with NUREG-1801, Section XI.E1.

Part 2

As indicated in LRA Section B.1.29, the RBS Non-EQ Insulated Cables and Connections Program will be consistent with NUREG-1801, Section XI.E1. The specific statement in NUREG-1801, Section XI.E1, under the corrective actions element is as follows.

> "All unacceptable visual indications of cable jacket and connection insulation surface anomalies are subject to an engineering evaluation. Such an evaluation is to consider the age and operating environment of the component as well as the severity of the anomaly and whether such an anomaly has previously been correlated to degradation of cables or connections."

The site support document, Aging Management Program Evaluation Results – Electrical, states the following for the corrective actions element.

> "When an unacceptable condition or situation is identified, the requirements of 10 CFR Part 50, Appendix B, will be used to address corrective actions."

The NUREG-1801 statement in the sentence that starts with, "such an evaluation," is describing the corrective action program; not the Non-EQ Insulated Cables and Connections Program. In Section B.0.3, the RBS LRA states that the corrective action controls of the RBS quality assurance (QA) program (10 CFR Part 50, Appendix B) are applicable to all aging management programs and activities through the period of extended operation.

The NUREG-1801 statement that discusses elements of an engineering evaluation under the corrective action program is not the controlling statement. The controlling statement is that RBS will perform an engineering evaluation as part of the corrective actions when an unacceptable condition or situation is identified, which will be controlled by the corrective action program not the Non-EQ Insulated Cables and Connections Program.

Because the statement for RBS performing an engineering evaluation is missing from the corrective actions element of the Non-EQ Insulated Cables and Connections Program, the site support document, Aging Management Program Evaluation Results – Electrical will be revised to include directions to perform an engineering evaluation.

Part 3

As indicated in LRA Section B.1.29, the RBS Non-EQ Insulated Cables and Connections Program will be consistent with NUREG-1801, Section XI.E1. For clarification, LRA Sections A.1.29 and B.1.29 are changed to remove the term "sample."

The changes to LRA Section A.1.29 and B.1.29 follow with additions underlined and deletions lined through.

A.1.29 Non-EQ Insulated Cables and Connections

The Non-EQ Insulated Cables and Connections Program provides reasonable assurance the intended functions of insulated cables and connections exposed to adverse localized environments caused by heat, radiation and moisture can be maintained consistent with the current licensing basis through the period of extended operation. An adverse localized environment is a condition in a limited plant area that is significantly more severe than the plant design environment for the cable or connection insulation materials.

Accessible insulated cables and connections within the scope of license renewal installed in an adverse localized environment will be visually inspected for cable and connection jacket surface anomalies, such as embrittlement, discoloration, cracking, melting, swelling, or surface contamination. The program inspection includes ~~sample consists of~~ all accessible cables and connections in localized adverse environments. ~~This program sample~~ The condition of accessible cables will represent, with reasonable assurance, all cables and connections in the adverse localized environment.

This program will visually inspect accessible cables in an adverse localized environment at least once every 10 years, with the first inspection prior to the period of extended operation.

This program will be implemented prior to the period of extended operation.

B.1.29 NON-EQ INSULATED CABLES AND CONNECTIONS

Program Description

The Non-EQ Insulated Cables and Connections Program is a new condition monitoring program that provides reasonable assurance the intended functions of insulated cables and connections exposed to adverse localized environments caused by heat, radiation and moisture can be maintained consistent with the current licensing basis through the period of extended operation. An adverse localized environment is a condition in a limited plant area that is significantly more severe than the plant design environment for the cable or connection insulation materials.

Accessible insulated cables and connections within the scope of license renewal installed in an adverse localized environment will be visually inspected for cable and connection jacket surface anomalies, such as embrittlement, discoloration, cracking, melting, swelling, or surface contamination, indicating signs of reduced insulation resistance. The program inspection includes ~~sample consists of~~ all accessible cables and connections in localized adverse environments. ~~This program sample~~ The condition of accessible cables will represent, with reasonable assurance, all cables and connections in the adverse localized environment.

An adverse localized environment is a plant-specific condition that will be determined based on the most limiting temperature, radiation, or moisture conditions for the cables and connection insulation material located at RBS within a plant space. Adverse localized environments can be identified through the use of an integrated approach. This approach may include, but is not limited to, (a) the review of Environmental Qualification (EQ) zone maps that show radiation levels and temperatures for various plant areas, (b) consultations with plant staff who are cognizant of plant conditions, (c) utilization of infrared thermography to identify hot spots on a real-time basis, and (d) the review of relevant plant-specific and industry operating experience. In addition, a survey method focused on plant-wide areas to determine potential adverse localized environments could be used.

This program will visually inspect accessible cables in an adverse localized environment at least once every 10 years, with the first inspection prior to the period of extended operation.

This program will be implemented prior to the period of extended operation.

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Enclosure 2

Voluntary License Renewal Application Change

Supplemental Change to LRA Table 3.3.2-18-13

Program for Managing the Effects of Aging in Condensation Environment

RBS has identified a change is necessary for LRA Table 3.3.2-18-13. Six component types in the HPCS diesel generator starting air system credit the Compressed Air Monitoring Program to manage the effects of aging in an internal environment of condensation. While this air system is equipped with dryers and filters, it does not undergo the sampling and monitoring activities specified in the Compressed Air Monitoring Program. In LRA Table 3.3.2-18-13, the six lines identifying the Compressed Air Monitoring Program are changed to credit the Internal Surfaces in Miscellaneous Piping and Ducting Components Program.

Changes to LRA Table 3.3.2-18-13 follow with additions underlined and deletions lined through.

Table 3.3.2-18-13
HPCS Diesel Generator System
Nonsafety-Related Components Affecting Safety-Related Systems
Summary of Aging Management Evaluation

Table 3.3.2-18-13: HPCS Diesel Generator System, Nonsafety-Related Components Affecting Safety-Related Systems								
Component Type	**Intended Function**	**Material**	**Environment**	**Aging Effect Requiring Management**	**Aging Management Program**	**NUREG-1801 Item**	**Table 1 Item**	**Notes**
Dryer housing	Pressure boundary	Carbon steel	Condensation (int)	Loss of material	~~Compressed Air Monitoring~~ Internal Surfaces in Miscellaneous Piping and Ducting Components	~~VII.D.A-26~~ VII.H2.A-23	~~3.3.1-55~~ 3.3.1-89	~~D~~ A
Filter housing	Pressure boundary	Carbon steel	Condensation (int)	Loss of material	~~Compressed Air Monitoring~~ Internal Surfaces in Miscellaneous Piping and Ducting Components	~~VII.D.A-26~~ VII.H2.A-23	~~3.3.1-55~~ 3.3.1-89	~~D~~ A
Piping	Pressure boundary	Carbon steel	Condensation (int)	Loss of material	~~Compressed Air Monitoring~~ Internal Surfaces in Miscellaneous Piping and Ducting Components	~~VII.D.A-26~~ VII.H2.A-23	~~3.3.1-55~~ 3.3.1-89	~~D~~ A

Table 3.3.2-18-13: HPCS Diesel Generator System, Nonsafety-Related Components Affecting Safety-Related Systems								
Component Type	**Intended Function**	**Material**	**Environment**	**Aging Effect Requiring Management**	**Aging Management Program**	**NUREG-1801 Item**	**Table 1 Item**	**Notes**
Silencer	Pressure boundary	Carbon steel	Condensation (int)	Loss of material	~~Compressed Air Monitoring~~ Internal Surfaces in Miscellaneous Piping and Ducting Components	~~VII.D.A-26~~ VII.H2.A-23	~~3.3.1-55~~ 3.3.1-89	~~D~~ A
Valve body	Pressure boundary	Carbon steel	Condensation (int)	Loss of material	~~Compressed Air Monitoring~~ Internal Surfaces in Miscellaneous Piping and Ducting Components	~~VII.D.A-26~~ VII.H2.A-23	~~3.3.1-55~~ 3.3.1-89	~~D~~ A
Valve body	Pressure boundary	Stainless steel	Condensation (int)	Loss of material	~~Compressed Air Monitoring~~ Internal Surfaces in Miscellaneous Piping and Ducting Components	~~VII.D.AP-81~~ VII.E5.AP-273	~~3.3.1-56~~ 3.3.1-95	~~D~~ C

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Enclosure 3

License Renewal Commitments

This table identifies actions discussed in this letter that Entergy commits to perform. Any other actions discussed in this submittal are described for the NRC's information and are **not** commitments.

Changes to LRA Section A.4 follow with additions underlined

A.4 LICENSE RENEWAL COMMITMENT LIST

No.	Program or Activity	Commitment	Implementation Schedule	Source (Letter Number)
2	Bolting Integrity	Enhance the Bolting Integrity Program as described in LRA Section A.1.2.	Prior to February 28, 2025.	RBG-47735 RBG-47828
19	Non-EQ Inaccessible Power Cables (≥ 400 V)	Implement the Non-EQ Inaccessible Power Cables (≥ 400 V) Program as described in LRA Section A.1.28.	Prior to February 28, 2025, or the end of the last refueling outage prior to August 29, 2025, whichever is later.	RBG-47735 RBG-47828
20	Non-EQ Insulated Cables and Connections	Implement the Non-EQ Insulated Cables and Connections Program as described in LRA Section A.1.29. Revise RBS report, Aging Management Program Evaluation Results – Electrical, to include directions to perform an engineering evaluation in the corrective actions program element.	Prior to February 28, 2025, or the end of the last refueling outage prior to August 29, 2025, whichever is later.	RBG-47735 RBG-47828