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10 CFR 50
10 CFR 51
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U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

Three Mile Island Nuclear Station, Unit 1.
Facility Operating License No. DPR-50
NRC Docket No.50-289

Subject: Response to NRC Request for Additional Information related to Three Mile Island Nuclear Station, Unit 1, License Renewal Application.

Reference: Letter from Mr. Jay Robinson (USNRC), to Mr. Michael P. Gallagher (AmerGen) "Request for additional information, Aging Management Review Results, Three Mile Island Nuclear Station, Unit 1, License Renewal Application", dated October 16, 2008. (TAC No. MD7701)

In the referenced letter, the NRC requested additional information related to Aging Management Review Results, of the Three Mile Island Nuclear Station, Unit 1, License Renewal Application (LRA). Enclosed are the responses to this request for additional information.

This letter and its enclosure contain no commitments.

If you have any questions, please contact Fred Polaski, Manager License Renewal, at 610-765-5935.

I declare under penalty of perjury that the foregoing is true and correct.

Respectfully,

Executed on 11-12-2008

Michael P. Gallagher
Vice President, License Renewal
AmerGen Energy Company, LLC

A131
NRR

Enclosure A: Response to Request for Additional Information, Aging Management Review Results, of the Three Mile Island Nuclear Station, Unit 1, License Renewal Application.

cc: Regional Administrator, USNRC Region I, w/Enclosure
USNRC Project Manager, NRR - License Renewal, Safety, w/Enclosure
USNRC Project Manager, NRR - License Renewal, Environmental, w/o Enclosure
USNRC Project Manager, NRR - TMIGS, w/o Enclosure
USNRC Senior Resident Inspector, TMIGS, w/o Enclosure

File No. 08001

Enclosure – A

Response to Request for Additional Information, Aging Management Review Results, of the Three Mile Island Nuclear Station, Unit 1, License Renewal Application.

Note: As a standard convention for AmerGen RAI responses, added text will be shown as ***bolded italics*** whereas deleted text will be shown as ~~strikethrough~~.

RAI#: AMR-GENERIC-1

LRA Section: 3.X.1 Tables, Associated Evaluation Paragraphs

Background:

In the Three Mile Island, Unit - 1, (TMI-1) License Renewal Application (LRA) for multiple line items in the 3.X.1 Tables and for associated evaluation paragraphs where the Generic Aging Lessons Learned (GALL) Report specifies further evaluation, line items that are designated as "not applicable" are explained with wording similar to the following:

> "The component, material, environment, and aging effect/mechanism does not apply to {systems}."

In the typical text "{systems}" is replaced with "Reactor Vessel, Internals, and Reactor Coolant System" or "ESF Systems" or "Auxiliary Systems," etc, as applicable.

Issue:

Although the staff believes it understands the intention of this wording, the wording is ambiguous because it could mean that "the component, material and environment combination does not exist in the system" but, as worded, it could also mean that "the component, material and environment combination exists but the aging effect does not occur in the system," in which case generic Note I would be applicable.

Request:

Please clarify the intention of this wording in unambiguous terms.

AmerGen Response

The wording "The component, material, environment, and aging effect/mechanism does not apply to {systems}," where the typical text "{systems}" is replaced with "Reactor Vessel, Internals, and Reactor Coolant System" or "ESF Systems" or "Auxiliary Systems," etc, as applicable, has been used under 2 separate circumstances. It has been used when the component, material and environment combination does not exist in the identified GALL system grouping. It has also been used when the component, material and environment combination does exist but the LRA Table 3.x.1 item was not used because a different Table 3.x.1 item was selected to manage the identified aging effect/mechanism.

Generic Note "I" in the LRA 3.x.2 AMR Tables is applied when the component, material and environment combination exists but the aging effect, or any of the identified aging mechanisms associated with the aging effect, in the selected NUREG-1801 line item does not occur. In these cases, the NUREG-1801 Table 1 item number is identified in the LRA 3.x.1 Tables as being applicable and the specific aging effect/mechanism that does not occur is identified in the item discussion column or in the evaluation paragraph where NUREG-1801 specifies further evaluation.

RAI#: 3.1.1-1

LRA Section(s): 3.1.1, Table of Summary of Aging Management Evaluations for the Reactor Vessel, internals, and Reactor Coolant System

Table 3.2.2-1, Core Flooding System, Summary of Aging Management Evaluation

Background:

In LRA Table 3.1.1 and Table 3.2.2-1, it is stated that American Society for Mechanical Engineering (ASME) Section XI Inservice Inspection (ISI) program, Subsections IWB, IWC, and IWD, Aging Management Program (AMP) B.2.1.1, are credited with aging management of Class 1 small-bore piping in lieu of the Gall Report AMP XI.M35, "One Time Inspection of ASME Code Class 1 Small-Bore Piping." The staff noted that XI.M35, One Time Inspection of ASME Code Class 1 Small-Bore Piping provides for one-time volumetric inspection of welds in small bore piping where cracking has not occurred.

Issue:

The discussion column of LRA Table 3.1.1, for Item No. 3.1.1-70 on page 3.1-36, indicates that TMI-1 has experienced an occurrence of cracking of ASME Code Class 1 small-bore piping resulting from thermal and mechanical cyclic loading and that the GALL Report AMP XI.M35 is not credited to manage degradation of Class 1 small-bore piping. However, the LRA does not provide the detail of the methods used to detect degradation (in particular cracking) of small bore piping (including inspection and evaluation methods, inspection scope and frequency) of the Reactor Coolant System and piping and fittings of the Core Flooding System (Table 3.2.2-1).

Request:

Provide additional information that provides the activities used to detect degradation of small bore piping.

AmerGen Response

The TMI-1 Inservice Inspection (ISI) program includes examination of small bore piping. The Risk Informed ISI (RISI) program includes small bore piping welds in a number of systems, including the Reactor Coolant System and the Core Flooding System. For the current third ten-year inspection interval (interval expires April 19, 2011), socket welds have been selected for VT-2 examination under the RISI program. Small bore butt welds have also been selected for ultrasonic and penetrant testing during the current third ten-year inspection interval. Socket welds and butt welds are selected for inspection in accordance with the RISI program, have been inspected during the second period of the interval, and are scheduled for inspection during the third period of the interval.

RAI#: 3.1.2.2.7-1

LRA Section: 3.1.2.2.7, Cracking due to Stress Corrosion Cracking

Background:

On page 3.1-10 of the LRA, in section 3.1.2.2.7.1, it is stated that Item 3.1.1-23 which refers to the stainless steel reactor vessel closure head flange leak detection line and the stainless steel bottom-mounted instrument guide tubes is not applicable to TMI-1.

Issue:

No additional information was found in the LRA to explain why this AMR result is not applicable for TMI-1.

Request:

With regard to the vessel closure head flange leak detection line and the bottom-mounted instrument guide tubes:

1. Do these components exist at TMI-1?
2. If these components exist, are they in scope for license renewal? If not, why not?
3. If these components exist and are in scope, what is the material of construction and environment for each component type? And, where are the AMR results for these components documented in the LRA?

AmerGen Response

1. These components do exist at TMI-1.

2. They are in scope for license renewal.

3. These components are included with the Reactor Vessel System, Class 1 piping, fittings and branch connections < NPS 4". The components are stainless steel with an external environment of Air with Borated Water Leakage and an internal environment of Reactor Coolant. The AMR results for these components are included in Table 3.1.2-2, Reactor Vessel, Summary of Aging Management Evaluation, and are shown on pages 3.1-74 and 3.1-75 of the LRA.

RAI#: 3.1.2.2.14-1

LRA Section: 3.1.2.2.14, Wall Thinning due to Flow-Accelerated Corrosion

Background:

On page 3.1-23 of the LRA in Table 3.1-1, Item 3.1.1-32 which applies to the component "steel steam generator feedwater inlet ring and supports" with "wall thinning due to flow accelerated corrosion" as an aging effect, references LRA section 3.1.2.2.14 to provide further discussion and states that the line is not applicable.

Issue:

On page 3.4-35 of the LRA in Table 3.4-1, Item 3.4.1-29, there is no discussion of steel steam generator feedwater inlet ring. It is further stated that the line item is not consistent with the GALL Report and provides an explanation for the emergency feedwater system. SRP-LR Section 3.1.2.2.14 states that wall thinning could occur in steel feedwater inlet rings and supports, and recommends a plant-specific program to be evaluated.

Request:

Provide justification why line item 3.1.1-32 is not applicable and explain how item 3.4.1-29 discussion applies to item 3.1.1-32.

AmerGen Response

Item Number 3.1.1-32 of Table 3.1.1 corresponds to a steam generator feedwater inlet ring internal to the steam generator which is associated with Westinghouse and Combustion Engineering Recirculating Steam Generators. The TMI-1 Once Through Steam Generator (OTSG) does not have a feedwater inlet ring internal to the OTSG so this item is not applicable. The feedwater inlet ring is external to the OTSG and is covered under Item 3.4.1-29 of Table 3.4.1. The discussion for Section 3.1.2.2.14 is for a feedwater inlet ring internal to the steam generator which is associated with Westinghouse and Combustion Engineering Recirculating Steam Generators and is not applicable to TMI-1. The item 3.4.1-29 discussion does not apply to item 3.1.1-32, however, the external feedwater inlet ring is covered under item 3.4.1-29. To eliminate confusion, the discussion for item 3.1.1-32 of Table 3.1.1 should read:

> Not applicable. ~~Wall thinning due to flow-accelerated corrosion in the steel feedwater inlet ring is discussed in Item Number 3.4.1-29~~. See Subsection 3.1.2.2.14.

In addition, the discussion for Section 3.1.2.2.14 should read:

> **3.1.2.2.14 Wall Thinning due to Flow-Accelerated Corrosion**
>
> Not Applicable. ***The discussion for Section 3.1.2.2.14 is for a feedwater inlet ring internal to the steam generator which is associated with Westinghouse and Combustion Engineering Recirculating Steam Generators and is not applicable to TMI-1.*** ~~Wall thinning due to flow-accelerated corrosion in the steel feedwater inlet ring is discussed in Item Number 3.4.1-29~~

RAI#: 3.1.2.3-1

LRA Section: Table 3.1.2-1, Reactor Coolant System

Background:

On page 3.4-50 of the LRA in rows 9 & 10 of Table 3.1.2-1, for piping and fittings made of lexan material in an air with borated water leakage environment, there are no aging effects requiring management identified.

Issue:

Justification for why there are no aging effects requiring management for the line item referenced above was not provided.

Request:

Provide justification why there are no aging effects requiring management for the material/environment combination identified above.

AmerGen Response

The line items shown in rows 9 and 10 of Table 3.1.2-1 on page 3.1-50 of the LRA correspond to the Reactor Coolant Pump (RCP) snubber hydraulic fluid reservoirs. There are four reservoirs, one for each snubber, associated with the four RCPs. These reservoirs are external to the snubbers and provide an external source of hydraulic fluid to the RCP snubbers. The reservoirs are connected to the snubbers with stainless steel tubing. During the screening of the RCS, the material of these reservoirs was identified as Lexan which is inaccurate. The actual material of the reservoirs is carbon steel. The reservoirs have a sight gauge which consists of steel and glass components. The aging management of the reservoirs is covered by the line items shown in rows 5, 6 of Table 3.1.2-1 on page 3.1-50 of the LRA and the changes shown below for row 10 of Table 3.1.2-1 on page 3.1-50 of the LRA. The steel and glass components of the sight glass should have been included in Table 3.1.2-1 on page 3.1-67 following the Restricting Orifices component.

Table 2.3.1-1, page 2.3-7, should have included the following line item (after the Restricting Orifices):

Component Type	Intended Functions
Sight Glasses	***Leakage Boundary***

Section 3.1.2.1.1, page 3.1-1, should have the following changes:

Materials
The materials of construction for the Reactor Coolant System components are:

- ***Glass***
- ~~Lexan~~

Table 3.1.2-1, page 3.1-50, should have Row 9 deleted and Row 10 modified as shown:

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
~~Piping and fittings~~	~~Leakage Boundary~~	~~Lexan~~	~~Air with Borated Water Leakage (External)~~	~~None~~	~~None~~			~~F, 5~~
Piping and fittings	Leakage Boundary	~~Lexan~~ ***Carbon Steel***	Lubricating Oil (Internal)	~~None~~ ***Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion***	~~None~~ ***Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.22)***	***VIII.G-6***	***3.4.1-12***	~~F, 5~~ ***E, 8***

Table 3.1.2-1, page 3.1-67, should have the following rows inserted after the existing row 10 (Restricting Orifices):

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Sight Glasses	***Leakage Boundary***	***Carbon Steel***	***Air with Borated Water Leakage (External)***	***Loss of Material/Boric Acid Corrosion***	***Boric Acid Corrosion (B.2.1.4)***	***IV.C2-9***	***3.1.1-58***	***A***
Sight Glasses	***Leakage Boundary***	***Carbon Steel***	***Air with Borated Water Leakage (External)***	***Loss of Material/General, Pitting and Crevice Corrosion***	***External Surfaces Monitoring (B.2.1.21)***	***V.E-4***	***3.2.1-23***	***E, 2***
Sight Glasses	***Leakage Boundary***	***Carbon Steel***	***Lubricating Oil (Internal)***	***Loss of Material/General, Pitting, Crevice, and Microbiologically Influenced Corrosion***	***Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.22)***	***VIII.G-6***	***3.4.1-12***	***E, 8***
Sight Glasses	***Leakage Boundary***	***Glass***	***Air with Borated Water Leakage (External)***	***None***	***None***			***G, 5***

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Sight Glasses	*Leakage Boundary*	*Glass*	*Lubricating Oil (Internal)*	*None*	*None*	*V.F-7*	*3.2.1-52*	*A*

Table 3.1.2-1, page 3.1-72, note 5 should have read:

5. ***Component contains glass material in air with borated water leakage environment. NUREG-1801 (V.F-6) lists glass with air (uncontrolled) environment as having no aging effect/mechanism and no AMP required. NUREG-1801 (V.F-9) lists glass in treated borated water environment as having no aging effect/mechanism and no AMP required.*** ~~There are no aging effects/mechanisms for polymer materials in an Air with Borated Water Leakage environment and Lubricating Oil. NUREG-1801 has no listing for polymer piping components.~~

Table 3.1.2-1, page 3.1-72, should have Note 8 added as follows:

8. This component, material, and environment combination is associated with Reactor Coolant Pump Snubber Reservoirs. Since the reservoirs and the snubber fluid are examined under existing work orders that are not associated with the Lubricating Oil Analysis and One-Time Inspection programs, these programs do not apply. The aging effects/mechanisms will be managed by the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program.

RAI#: 3.2.2.2.6-1

LRA Section: 3.2.2.2.6, Loss of Material Due to Erosion

Background:

On page 3.2-53 of the LRA in Table 3.2.2-3 for the Makeup and Purification System (High Pressure Injection), the AMR result for a stainless steel flow element in a treated water environment with an aging effect of loss of material/erosion shows that the Water Chemistry (B.2.1.2) AMP is the only AMP credited. On page 3.2-14 of the LRA in section 3.2.2.2.6, it is stated that plant Technical Specifications require periodic surveillance testing of the pumps which would give early indication of orifice degradation.

Issue:

In the GALL Report, the corresponding AMR result line recommends further evaluation, and the SRP-LR Section 3.2.2.2.6 recommends that a plant-specific AMP be evaluated. Since the pump testing would give only an indirect indication of orifice degradation due to erosion, and may not give any indication until significant degradation has occurred, the Staff is not convinced that the Water Chemistry Program, alone, provides adequate aging management for this aging effect in this component.

Request:

Provide an additional AMP to directly confirm the effectiveness of the Water Chemistry Program in managing the aging effect of loss of material due to erosion in this component, or provide a detailed technical justification of why an additional AMP is not needed.

AmerGen Response

An additional Aging Management Program, the One-Time Inspection program, B.2.1.18, will be credited for this component type to confirm the effectiveness of the Water Chemistry program, B.2.1.2, to manage loss of material due to erosion in the stainless steel high-pressure injection pump recirculation orifices. An inspection of the orifice for the "B" pump will be performed, as this is the pump that is most commonly used for normal charging and makeup flow. This one-time inspection will consist of a volumetric examination (e.g., RT) and will be performed prior to entering the period of extended operation.

With this change, LRA Section 3.2.2.2.6 changes as follows:

> TMI-1 will implement ***a One-Time Inspection program, B.2.1.18, to verify the effectiveness of*** the Water Chemistry program, B.2.1.2, to manage the loss of material due to erosion in the stainless steel high-pressure injection pump recirculation flow orifices. As further assurance, plant Technical Specifications require periodic surveillance testing of the pumps which would give early indication of orifice degradation. ***The one-time inspection of the "B" pump orifice will be performed prior to entering the period of extended operation.*** The Water Chemistry ***and One-Time Inspection*** program***s are*** ~~is~~ described in Appendix B.

The LRA Table 3.2.1, Item Number 3.2.1-12, "Discussion" column entry changes as follows:

> The ***One-Time Inspection program, B.2.1.18, will be used to verify the effectiveness of the*** Water Chemistry program, B.2.1.2, ~~will be used~~ to manage the loss of material due to erosion in the stainless steel high-pressure injection pump recirculation flow orifices in a treated water environment.
>
> See Subsection 3.2.2.2.6.

LRA Table 3.2.2-3 changes to include the additional line item and the addition to Note 11 as follows:

Table 3.2.2-3 Makeup and Purification System (High Pressure Injection)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG -1801 Vol. 2 Item	Table 1 Item	Notes
Flow Element	***Pressure Boundary***	***Stainless Steel***	***Treated Water (Internal)***	***Loss of Material/Erosion***	***One-Time Inspection (B.2.1.18)***	***V.D1-14***	***3.2.1-12***	***E, 11***

11. NUREG-1801 specifies a plant-specific program for this component, material, environment, and aging mechanism combination. The Water Chemistry program ***and One-Time Inspection program are*** ~~is~~ used to manage loss of material due to erosion.

RAI#: 3.3.1.21-1

LRA Section: Table 3.3.1, Summary of Aging Management Evaluations for the Auxiliary Systems, Item 3.3.1-21

Background:

On page 3.3-58 of the LRA in Table 3.3.1, the discussion column for item 3.3.1-21 (steel heat exchanger components exposed to lubricating oil) states: "Not consistent with NUREG-1801." It also states that: "Fouling is not predicted for this component, material and environment combination."

Issue:

For managing the other aging effects of general, pitting, and crevice corrosion, and microbiologically influenced corrosion (MIC) for steel piping, piping components, and piping elements exposed to lubricating oil in the RCS, the LRA specifies the use of the Lubricating Oil Analysis (B.2.1.23) AMP and the One-Time Inspection (B.2.1.18) AMP, which are the same AMPs recommended in the GALL Report for item 3.3.1-21.

Request:

1. Provide justification for the LRA's statement that the aging effect of fouling "is not predicted for this component, material and environment combination."

2. Explain why the LRA states that the item is not consistent with the GALL Report and uses generic Note "I", indicating that the aging effect in the GALL Report does not apply for this component, material, and environment combination.

AmerGen Response

1. The aging effect, loss of material, is predicted for the Reactor Coolant System pump casings and valve bodies, but only due to the aging mechanisms of general, pitting, crevice and microbiologically influenced corrosion, not the aging mechanism of fouling. This is consistent with EPRI Report 1010639, Non-Class 1 Mechanical Tools, Revision 4, Appendix C, Table 4-1, which does not predict the loss of material due to fouling in steel components exposed to lubricating oil.

2. As discussed in the response to part 1 of the question, the aging mechanism of Fouling is not applicable to the Reactor Coolant System pump casings and valve bodies. Since this aging mechanism is not applicable, Note I is appropriate and the item is not consistent with the aging mechanism in NUREG-1801 for line item 3.3.1-21.

RAI#: 3.3.1.32-1

LRA Section: Table 3.3.1, Summary of Aging Management Evaluations for the Auxiliary Systems, Item 3.3.1-32

Background:

In LRA Tables 3.3.2-2, -9, -12 and -24, for AMR results that refer to Table 3.3.1, Item 3.3.1-32, where the material is copper alloy with less than 15% Zinc, generic Note "I" is used, along with a plant specific note that states: "pitting and crevice corrosion are not predicted for this combination, and microbiologically influenced corrosion is predicted for this combination."

Issue:

Justification indicating that "pitting and crevice corrosion are not predicted" is not provided. Since loss of material due to MIC is predicted, no explanation is given as to why generic Note "I" is used. It is not clear as to why item number 3.3.1-32 states "Not consistent with NUREG-1801", when the AMPs all appear to match the GALL Report's comparable AMR result.

Request:

1. Provide technical justification, including applicable technical reference(s), for the statement that "pitting and crevice corrosion are not predicted."
2. Would one-time inspection procedures be materially changed if pitting and crevice corrosion were predicted for the components in which only MIC is currently predicted? If so, in what ways would the procedures be changed?
3. Explain why generic Note "I" is used since loss of material due to MIC is predicted.
4. Since component, material, environment, aging effect (except due to certain mechanisms) and the AMPs all appear to match the GALL Report's comparable AMR result, explain why the discussion for Item 3.3.1-32 states, "Not consistent with NUREG-1801."

AmerGen Response

1. Item Number 3.3.1-32 in LRA Table 3.3.1 and LRA Section 3.3.2.2.12.1 state that the loss of material due to pitting and crevice corrosion in copper alloy with less than 15 percent zinc is not predicted in a fuel oil environment. This is not consistent with NUREG-1800 Table 3.3-1, ID 32 and NUREG-1801, Vol. 1, Table 3, ID 32 which cite pitting and crevice corrosion as applicable aging mechanisms for "copper alloy" exposed to fuel oil. This inconsistency arises because these NUREG-1800 and NUREG-1801 items do not provide the distinction between "copper alloy with 15% zinc or more" and "copper alloy with less than 15% zinc" which has been made in the TMI-1 LRA Table 3.x.2 aging management evaluations.

   Appendix C of EPRI Report 1010639, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 4," dated January 2006, was used as the basis for the identification of aging effects/mechanisms for copper and copper alloys in a fuel oil environment. The TMI-1 fuel oil environment includes the assumption of the presence of water contamination and water pooling/separation. For copper alloy with 15% zinc or more, pitting and crevice corrosion is predicted in this environment. For copper alloy with less than 15% zinc, pitting and crevice corrosion is not predicted in this environment. Therefore, TMI-1 copper alloys with zinc content less than 15% are not subject to pitting and crevice corrosion in a fuel oil environment.

2. No, the one-time inspection volumetric examination procedures would not change if pitting and crevice corrosion were predicted along with MIC.

3. Standard Note "I" is used to indicate "Aging effect in NUREG-1801 for this component, material and environment combination is not applicable." There are no NUREG-1801 line items for copper alloy in fuel oil that include loss of material due to MIC without including loss of material due to pitting and crevice corrosion. It was AmerGen's position that the Standard Notes applied to aging effect and mechanism, not aging effect only. As such, AmerGen chose to indicate loss of material due to MIC was predicted for these components but pitting and crevice corrosion was not predicted by citing the applicable NUREG-1801 Volume 2 Items and by using an "I."

4. It was AmerGen's practice to note all places where the LRA did not exactly match NUREG-1801, including aging mechanisms. Since loss of material due to pitting and crevice corrosion was not predicted for these components, the Discussion for Item 3.3.1-32 stated, "Not consistent with NUREG-1801."

RAI#: 3.3.1-48-1

LRA Section: Table 3.3.1, Summary of Aging Management Evaluations for the Auxiliary Systems

Background:

For a number of AMR results lines where the aging effect is loss of material, the LRA uses generic Note "I" and a plant-specific note stating that galvanic corrosion is not applicable for this component due to absence of unlike materials to form a galvanic couple – or similar wording. Similarly, for a stainless steel structural support in treated water, the aging effect of general corrosion (but not pitting and crevice corrosion) is denied and Note "I" is used. See Item 3.3.1-48 on page 3.3-72; Item 3.3.1-51 on page 3.3-74; Item 3.3.1-82 on page 3.3-94, and Item 3.4.1-5 on page 3.4-24.

Issue:

Note "I" means that the aging effect in the GALL Report is not applicable for the component, material and environment combination. However, it appears that Note "I" is being used to indicate that a specific aging mechanism (not an aging effect) is not present.

Request:

Explain why the use of Note "I" is considered to be appropriate for these types of line items.

AmerGen Response

Generic Note "I" in the LRA 3.x.2 AMR tables is applied when the component, material and environment combination exists but the aging effect, or any of the identified aging mechanisms associated with the aging effect, in NUREG-1801 is not predicted. In these cases, the NUREG-1801 Table 1 item number is identified in the LRA 3.x.1 aging management summary tables as being applicable and the specific aging effect/mechanism that is not predicted is identified in the item discussion column or in the evaluation paragraph where NUREG-1801 specifies further evaluation (refer to AmerGen response to RAI#: AMR-GENERIC-1).

EPRI Report 1010639, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools," Revision 4, dated January 2006, was used as the basis for the identification of aging effects/mechanisms for the LRA 3.x.2 AMR tables. LRA Table 3.x.1 Item Numbers 3.3.1-48, 3.3.1-51, 3.3.1-82, and 3.4.1-5 include the loss of material due to galvanic corrosion in addition to general, pitting, crevice, microbiologically influenced corrosion (MIC), and fouling. In accordance with EPRI Report 1010639, galvanic corrosion is not predicted for component, material, and environment combinations when the material subject to AMR is not in contact with a material of different electrochemical potential. In these cases, the Table 3.x.2 AMR line items are identified with generic note "I." Although galvanic corrosion is not predicted for every Table 3.x.2 component, material, and environment combination that invokes these Table 3.x.1 item numbers, the remaining mechanisms do apply and the identified aging management programs are appropriate for the management of these corrosion mechanisms.

LRA Table 3.5.1 Item Number 3.5.1-49 applies to both carbon and stainless steel structural support components in a treated water environment and includes the loss of material due to the aging mechanism of general corrosion in addition to the mechanisms of pitting and crevice corrosion. General, pitting, and crevice corrosion are applicable aging mechanisms for the LRA 3.x.2 AMR table carbon steel structural support components. Pitting and crevice corrosion are applicable aging mechanisms for the LRA 3.x.2 AMR table stainless steel structural support components. The Table 3.x.2 stainless steel line items are identified with generic note "I" since general corrosion has not been predicted as an applicable aging mechanism. Although general corrosion is not applicable for the Table 3.x.2 stainless steel structural support components that invoke Item Number 3.5.1-49, the remaining mechanisms of pitting and crevice corrosion do apply and the identified aging management programs are appropriate for the management of these corrosion mechanisms.

RAI#: 3.3.2.2-1

LRA Section: 3.3.2.2, Aging Management Review (AMR) Results for Which Further Evaluation is Recommended by the GALL Report

Background:

In various parts of LRA Section 3.3.2.2, it is stated that loss of material due to crevice corrosion in copper alloys with zinc content less than 15% is not predicted in a fuel oil environment.

Issue:

Sufficient information is not provided in the LRA to verify that loss of material due to crevice corrosion in copper alloys with zinc content less than 15% will not occur in a fuel oil environment.

Request:

Provide additional information that demonstrates copper alloys with zinc content less than 15% are not subject to pitting and crevice corrosion in a fuel oil environment.

AmerGen Response

Item Number 3.3.1-32 in LRA Table 3.3.1 and LRA Section 3.3.2.2.12.1 state that the loss of material due to pitting and crevice corrosion in copper alloy with less than 15 percent zinc is not predicted in a fuel oil environment. This is not consistent with NUREG-1800, Table 3.3-1, ID 32 and NUREG-1801, Vol. 1, Table 3, ID 32 which cite pitting and crevice corrosion as applicable aging mechanisms for "copper alloy" exposed to fuel oil. These NUREG-1800 and NUREG-1801 items do not provide the distinction between "copper alloy with 15% zinc or more" and "copper alloy with less than 15% zinc" that has been made in the TMI-1 LRA Table 3.x.2 aging management evaluations.

Appendix C of EPRI Report 1010639, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools," Revision 4, dated January 2006, was used as the basis for the identification of aging effects/mechanisms for copper and copper alloys in a fuel oil environment. The TMI-1 fuel oil environment includes the assumption of the presence of water contamination and water pooling/separation. For copper alloy with 15% zinc or more, pitting and crevice corrosion is predicted in this environment. For copper alloy with less than 15% zinc, pitting and crevice corrosion is not predicted in this environment. Therefore, TMI-1 copper alloys with zinc content less than 15% are not subject to pitting and crevice corrosion in a fuel oil environment.

RAI#: 3.3.2.2-2

LRA Section: 3.3.2.2, Aging Management Review (AMR) Results for Which Further Evaluation is Recommended by the GALL Report

Background:

In Auxiliary System Tables 3.3.2-2, 3.3.2-9, 3.3.2-12, and 3.3.2-24, it is stated that for copper alloy (Zn content less 15%) piping, fittings, and valves exposed to a fuel oil environment, loss of material due microbiologically influence corrosion (MIC) is managed with the Fuel Oil Chemistry (B.2.16) and One-Time Inspection (B.2.1.18) programs.

Issue:

Note "I" which states that the aging effect in the Gall Report for the component, material, and environment combination is not applicable, is assigned for these cases even though the assignment of the Fuel Oil Chemistry and One-Time Inspection program to manage loss of material due to MIC is in accordance with the GALL Report. In addition, loss of material due to MIC for copper alloys with zinc content less than 15% is addressed in Section 3.3.2.2.12 of the LRA.

Request:

Provide additional information that justifies using note "I" for copper alloy (Zn content less 15%) piping, fittings, and valves exposed to a fuel oil environment, when loss of material due to MIC is managed with the Fuel Oil Chemistry (B.2.16) and One-Time Inspection (B.2.1.18) programs in accordance with the GALL Report.

AmerGen Response

Generic Note "I" in the TMI-1 LRA 3.x.2 AMR Tables is applied when the material, component, and environment combination exists but the aging effect, or any of the identified aging mechanisms associated with the aging effect, in NUREG-1801 does not occur (refer to AmerGen's response to RAI#: AMR-GENERIC-1).

In Auxiliary System Tables 3.3.2-2, 3.3.2-9, 3.3.2-12, and 3.3.2-24, NUREG-1801, Vol. 2 Item VII.H1-3 is applied to the material, component, and environment combination of copper alloy with less than 15% zinc piping, fittings, and valves exposed to a fuel oil environment. NUREG-1801, Vol. 2 Item VII.H1-3 includes the loss of material due to pitting, crevice, and microbiologically influenced corrosion (MIC) and specifies the Fuel Oil Chemistry (B.2.1.16) and One-Time Inspection (B.2.1.18) programs for managing these aging mechanisms.

For TMI-1, the aging mechanisms of pitting and crevice corrosion are not predicted in copper alloy with less than 15% zinc piping, fittings, and valves exposed to a fuel oil environment (refer to AmerGen's response to RAI#: 3.3.2.2-1). Although the aging mechanisms of pitting and crevice corrosion are not predicted, the loss of material due to MIC is still predicted for this component, material, and environment combination, and, the Fuel Oil Chemistry (B.2.1.16) and One-Time Inspection (B.2.1.18) programs are appropriate for managing this aging mechanism. Therefore, NUREG-1801, Vol. 2 Item VII.H1-3 was used with Generic Note "I" and a plant specific note identifying that the aging mechanisms of pitting and crevice corrosion did not apply to this material, component, and environment combination.

RAI#: 3.3.2.2-3

LRA Section: 3.3.2.2, Aging Management Review (AMR) Results for Which Further Evaluation is Recommended by the GALL Report

Background:

On page 3.3-39 of the LRA, in section 3.3.2.2.9.2, it is stated that fouling of heat exchanger steel piping, piping components, and piping elements exposed to a lubricating oil environment is not predicted and therefore it is not addressed.

Issue:

Fouling of heat exchanger steel piping, piping components, and piping elements exposed to a lubricating oil environment is not addressed.

Request:

Provide additional information that demonstrates steel piping, piping components and piping elements are not subject to fouling when exposed to lubricating oil.

AmerGen Response

Item Number 3.3.1-21 in LRA Table 3.3.1 and LRA Section 3.3.2.2.9.2 address the loss of material due to general, pitting, crevice, MIC, and fouling in steel components exposed to lubricating oil. These portions of the LRA identify that fouling is not predicted in steel piping, piping components, and piping elements exposed to lubricating oil. This is in disagreement with NUREG-1800 Table 3.3-1, ID 21 and NUREG-1801, Vol. 1, Table 3, ID 21, which cite the loss of material due to fouling as an applicable aging effect/mechanism for steel heat exchanger components exposed to lubricating oil.

Appendix C of EPRI Report 1010639, “Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools,” Revision 4, dated January 2006, was used as the basis for the identification of aging effects/mechanisms for steel in a lubricating oil environment. Appendix C of the Mechanical Tools does not predict the loss of material due to fouling in steel components exposed to lubricating oil.

RAI#: 3.3.2.3-1

LRA Section: Table 3.3.2-10, Fire Protection System
Table 3.3.2-11, Fuel Handling and Fuel Storage System
Table 3.3.2-18, Miscellaneous Floor and Equipment Drains System
Table 3.3.2-21, Radwaste System

Background:

The LRA identifies several elastomer/polymer components/material environment grouping combinations with an aging effect of "none" and an aging management program of "none" and references footnote F in auxiliary systems as follows:

1. Table 3.3.2-10, page 3.3-211, rows 5 and 6: Polymer piping and fittings in the fire protection system in air-indoor external and air/gas wetted internal environments.

2. Table 3.3.2-11, page 3.3-236, rows 1 & 2: Tygon hoses in fuel handling and fuel storage system in air with borated water leakage external and treated water internal environments.

3. Table 3.3.2-18, page 3.3-279, row 10 & Table 3.3.2-18, page 3.3-280, rows 1 through 3: Various organic polymers tanks in the miscellaneous floor and equipment drains system in air with borated water leakage, air/gas – wetted, concrete, and raw water environments.

4. Table 3.3.2-21, page 3.3-323, row 11: Titanium alloy tank in radwaste system in air with borated water leakage environment.

Issue:

The polymer material for piping and fittings and tanks is not identified. Justification for why there are no aging effects requiring management for the line items referenced above was not provided.

Request:

1. Identify what polymer material is used for piping and fittings, and tanks.

2. Provide justification for why there are no aging effects requiring management for the material/environment combinations identified above.

AmerGen Response

Item 1: The polymer piping and fitting component used in the fire protection system is Nylon 11 tubing, and it is located inside the Control Building. Nylon 11 is a polyamide material with excellent resistance to acids, including boric acid. It is heat and light stabilized, with a maximum operating temperature of 70°C (158°F). Nylon 11 is resistant to moisture absorption, corrosion, and stresscracking, and has good flexibility. The design temperature for the Control Building is 80°F and the radiation level is negligible. Therefore, there are no aging effects that would result from the Nylon 11 tubing contacting the air-indoor (external) and the air/gas – wetted (internal) environments inside the Control Building.

Item 2: The Tygon tubing is used inside the Auxiliary building as a sight hose for the fuel transfer tube drain line. Tygon tubing is made from plasticized vinyl (polyvinyl chloride) and it has excellent chemical resistance to water and to acids, including boric acid. Tygon tubing has a maximum recommended operating temperature of 165°F and has a radiation damage threshold of 5×10^5 rads. The design temperature for the Auxiliary Building is 104°F and the maximum radiation level at the service location is 1.3×10^4 rads in 60 years. Therefore, there are no aging effects that would result from using the Tygon tubing inside the Auxiliary Building where it contacts the treated water (internal) environment and the air with borated water leakage (external) environment.

Item 3. These line items refer to a fiberglass liner used inside the Tendon Access Gallery Sump. Fiberglass is a composite material comprised of glass fibers and a polyester or epoxy resin. Fiberglass composites have excellent moisture resistance and chemical resistance to many corrosive materials, including acids (specifically including boric acid), chlorides, nitrates, and sulfates. The maximum recommended operating temperature for fiberglass is 200°F. The average normal operating temperature of the Tendon Access Gallery is 85°F and the radiation level is negligible. Therefore, there are no aging effects that result from using the fiberglass sump liner inside the Tendon Access Gallery where it contacts concrete, air with borated water leakage, air-gas (wetted), and raw water environments.

Item 4. Titanium offers outstanding resistance to a wide variety of environments, including oxidizing, neutral, and inhibited reducing conditions. It also remains passive under mildly reducing conditions. Titanium is not susceptible to boric acid corrosion, based upon corrosion testing performed by the titanium manufacturer. Based on these material properties, titanium is not susceptible to aging effects in the air with borated water leakage environment.

RAI#: 3.3.2-3-1

LRA Section: Table 3.3.2-3, Circulating Water System

Background:

On page 3.3-127 of the LRA, row 8 in Table 3.3.2-3 refers to Table 1 item 3.5.1-27, for piping and fittings made of concrete in a raw water (internal) environment where the aging effect is cracking due to expansion and reaction with aggregates and is managed by the Open-Cycle Cooling Water System (B.2.1.9) AMP.

On page 3.3-127 of the LRA, row 7 of Table 3.3.2-3, and on page 3.3-128 of the LRA, row 1 of Table 3.3.2-3, refer to Table 1 item 3.5.1-31. Both line items are for piping and fittings made of concrete in a raw water (internal) environment. For the item on page 3.3-127 the aging effect is cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel; for the item on page 3.3-128, the aging effect is increase in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack. For both items the Open-Cycle Cooling Water System (B.2.1.9) AMP is credited.

On page 3.3-128 of the LRA, row 2 of Table 3.3.2-3 refers to Table 1 item 3.5.1-37 for piping and fittings made of concrete in a raw water (internal) environment where the aging effect is increase in porosity and permeability and loss of strength due to leaching of calcium hydroxide.

Issue:

In order to complete the review, a more detailed description of the components included in the above reference line items is needed along with a more detailed description of the examination techniques used to detect each of the aging effects listed in the AMR result.

Request:

1. Provide a more detailed description of the components that are included in these line items (i.e. pipe size, type of fittings, construction of the pipe, etc.).
2. Provide a more detailed description of the examination techniques used to detect each of the aging effects listed in the AMR result. (How the examination is conducted, what frequency, what acceptance criteria is used for identifying age-related degradation?)
3. Identify any preventive actions in the Open-Cycle Cooling Water System AMP that mitigate aging effects.

AmerGen Response

1. The circulating water system concrete piping is prestressed concrete embedded steel cylinder pipe. The piping diameter is 102 inches. The pipe core consists of a steel cylinder encased in concrete. The core is reinforced with high-tensile wire wound around the outer surface of the core. A coating of concrete covers the core and wire except for the exposed surfaces of the joint rings. The piping joints are a bell and spigot design with a rubber gasket between spigot and bell rings to ensure the joint is watertight. Both the outer and inner surfaces of the joints are sealed with mortar after installation.

2. Internal inspection of the circulating water piping is performed by visual examination of all concrete piping. The inspection is performed every two years during refueling outages. The inspection requires that the circulating water piping be drained. Acceptance criteria include evidence of cracking, dimensional or continuity changes, spalling, increased porosity and permeability, missing or degraded seals, and silt. Irregularities identified in the concrete piping are documented by photography and entered into TMI-1 Corrective Action Program.

3. The Open Cycle Cooling Water AMP includes preventative actions to mitigate aging effects of the concrete circulating water piping. These include chemical treatment to maintain circulating water in the alkaline pH range, which prevents decalcification of the concrete piping. Additionally, a scaling inhibitor is utilized to prevent scaling of the concrete typically seen at these higher pH values.

RAI#: 3.3.2-10-1

LRA Section: Table 3.3.2-10, Fire Protection System

Background:

On page 3.3-206 of the LRA, in row 8 of Table 3.3.2-10, and on page 3.3-207 of the LRA, in row 5 of Table 3.3.2-10, for carbon steel fire barriers (doors and penetration seals), in an environment of air with borated water leakage, the Fire Protection AMP is credited and the GALL Report item VII.A1-1 is referenced along with footnote E.

Issue:

The GALL Report item VII.A1-1 is for structural steel in air-indoor uncontrolled environment, which is a different environment than what is identified in the LRA. Also, the Fire Protection AMP is credited in lieu of Boric Acid Corrosion AMP.

Request:

1. Explain why the GALL Report item VII.A1-1 is referenced instead of the GALL Report item III.B5-8 (support members; welds; bolted connections; support anchorage to building structure in an environment of air with borated water leakage), which is what is referenced for doors in LRA Tables 3.5.2-2 and 3.5.2-7 (see row 2 on page 3.5-82 and row 1 on page 3.5-131) for steel material in an environment of air with borated water leakage.

2. Provide justification for why the Fire Protection AMP is referenced and not the Boric Acid Corrosion AMP.

3. If the Fire Protection AMP is used, explain which AMP will be used to evaluate and control boric acid leakage.

AmerGen Response

1. Per AmerGen's process for identifying predicted aging effects and mechanisms, carbon steel components in an air with borated water leakage environment are subject to loss of material due to boric acid corrosion and general, pitting, and crevice corrosion. NUREG-1801 item VII.A1-1 was referenced for loss of material due to general, pitting, and crevice corrosion and item VII.I-10 was referenced, instead of III.B5-8, for loss of material due to boric acid corrosion.

   NUREG-1801 item VII.A1-1 and VII.I-10 are referenced because fire doors and penetration seals are addressed in NUREG-1801, Chapter VII, Auxiliary Systems and evaluated for TMI-1 in LRA Section 3.3, Aging Management of Auxiliary Systems, whereas non-fire doors are incorporated into NUREG-1801, Chapter III, Structures and Component Supports and evaluated for TMI-1 in LRA Section 3.5, Containments, Structures, and Component Supports.

2. TMI-1 credits both the Boric Acid Corrosion and Fire Protection programs for managing aging of the fire doors and penetration seals. As shown on Table 3.3.2-10, the Boric Acid Corrosion program is credited for managing loss of material due to boric acid

corrosion (LRA page 3.3-206, row 7 and page 3.3-207, row 4) and the Fire Protection program is credited for managing loss of material due to general, pitting, and crevice corrosion (LRA page 3.3-206, row 8 and page 3.3-207, row 5).

3. The Fire Protection AMP is not credited for managing boric acid corrosion or borated water leakage. All boric acid leakage will be evaluated and controlled by Boric Acid Corrosion program.

RAI # 3.3.2-24-1

LRA Section: Table 3.3.2-24, Station Blackout and UPS Diesel Generator Systems

Background:

On page 3.3-345 of the LRA, row 9 of Table 3.3.2-24, is for stainless steel piping and fittings in an environment of fuel oil (internal) where the AMP is One-Time Inspection (B.2.1.18).

Issue:

The Fuel Oil Chemistry (B.2.1.16) AMP does not appear to be credited for aging management of this component.

Request:

Indicate if the correct AMP is credited. If yes, then explain why the Fuel Oil Chemistry AMP is not credited for aging management of this component.

AmerGen Response:

The Fuel Oil Chemistry AMP should have been credited for aging management of this component along with the One-Time Inspection AMP (B.2.1.18). In addition, row 9 should not have included "General" corrosion as an aging mechanism because it is not applicable for this material and environment combination.

As a result, Table 3.3.2-24 on page 3.3-345 of the LRA should have included an additional line item following row 9 for Piping and Fittings as follows and row 9 should have read as shown:

Table 3.3.2-24 Station Blackout and UPS Diesel Generator Systems

Component Type	Intended Function	Material	Environ.	Aging Effect Requiring Management	Aging Mgt. Programs	NUREG -1801 Vol. 2 Item	Table 1 Item	Notes
Piping and Fittings	Pressure Boundary	Stainless Steel	Fuel Oil (Internal)	Loss of Material/ ~~General~~, Pitting, Crevice, and Microbiologically Influenced Corrosion	One-Time Inspection (B.2.1.18)	VII.H1-6	3.3.1-32	B
Piping and Fittings	***Pressure Boundary***	***Stainless Steel***	***Fuel Oil (Internal)***	***Loss of Material/ Pitting, Crevice, and Microbiologically Influenced Corrosion***	***Fuel Oil Chemistry (B.2.1.16)***	***VII.H1-6***	***3.3.1-32***	***B***

RAI#: 3.3.2-25-1

LRA Section: Table 3.3.2-25, Water Treatment and Distribution System, Summary of Aging Management Evaluation

Background:

In LRA Table 3.3.2-25, for components made of carbon steel, ductile cast iron and gray cast iron exposed to a raw water environment in the water treatment and distribution system, the aging effect of loss of material is managed by the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.22) AMP, rather than by the Open-Cycle Cooling Water (B.2.1.9) AMP. Items include: Row 4 on page 3.3-356; Rows 1 and 5 on page 3.3-357; Row 9 on page 3.3-358; Rows 1, 2, 4 and 6 on page 3.3-360; Rows 1, 3 and 5 on page 3.3-362; Rows 3 and 8 on page 3.3-363; and, Rows 3 and 5 on page 3.3-365.

Issue:

The GALL Report recommends use of the Open-Cycle Cooling Water AMP for this component, material, environment and aging effect combination.

Request:

1. Explain why a different AMP from the one recommended in the GALL Report is being used?
2. Provide justification and explain how the AMP used provides aging management protection for the identified components that is comparable to the protection that would be provided by the AMP recommended in the GALL Report.

AmerGen Response

1. The raw water environment in the Water Treatment and Distribution System AMR Table 3.3.2-25 includes domestic water, filtered water, and other non-demineralized water sources. These environments are not considered raw cooling water and, as such, are not addressed by the activities of aging management program B.2.1.9, "Open-Cycle Cooling Water System." These environments also are not addressed by the activities of aging management program B.2.1.2, "Water Chemistry."

   Aging management program B.2.1.22, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components" consists of inspections of the internal surfaces of piping, piping components, and piping elements that are not covered by other aging management programs. Therefore, the aging management of Water Treatment and Distribution System components exposed to this raw water environment has been included in the activities of aging management program B.2.1.22, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components."

2. Aging management program B.2.1.22, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components" includes internal inspections that are performed during periodic system and component inspections and during the performance of maintenance activities when the surfaces are made accessible for inspection. The program includes visual inspections to assure that environmental conditions are not resulting in material

degradation (i.e., the loss of material due to general, pitting, crevice, and microbiologically influenced corrosion, and fouling) that could result in a loss of component intended functions. Qualified personnel will perform these visual inspection activities. Material degradation identified during the inspections will be entered into the corrective action process for further evaluation.

RAI#: 3.4.2.3-1

LRA Section: Table 3.4.2-6, Main Generator and Auxiliary Systems

Background:

On page 3.4-120 of the LRA in rows 5 and 6, of Table 3.4.2-06, for PTFE piping and fittings in air-indoor and treated water environments, there are no aging effects requiring management identified.

Issue:

Justification for why there are no aging effects requiring management for the line item referenced above was not provided.

Request:

Provide justification why there are no aging effects requiring management for the material/environment combination identified above.

AmerGen Response

The polytetrafluoroethylene (PTFE) tubing (also known as Teflon) piping and fittings are located within the generator exciter power rectifier cabinets in the Turbine Building. They are used to transport stator cooling water through the exciter power rectifiers. These PTFE components are resistant to aging effects associated with both the air-indoor (external) and treated water (internal) environments. The continuous service temperature rating for PTFE is 500°F, which bounds that of the service environment. PTFE is chemically resistant to all common solvents, acids, and bases, and is chemically inert. PTFE has a relatively low radiation damage threshold of 2×10^4 rads, but the service location in the Turbine Building is a very low radiation area, so aging effects associated with radiation damage are not applicable. Since there are no aging effects identified that would affect this material in the given service environment, none were identified in the Aging Management Review.

RAI#: 3.4.2-8-1

LRA Section: Table 3.4.2-8, Steam Turbine and Auxiliary Systems

Background:

In LRA Table 3.4.2-8, row 6, on page 3.4-154, it is proposed to manage loss of material due to erosion for carbon steel piping and fittings in a treated water (external) environment with AMP B.2.1.22, "Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components."

Issue:

It is not clear how the inspection of the internal surfaces of piping and fittings will be representative of the degradation that has occurred on the external surface due to the external treated water environment.

Request:

Clarify how the inspection of the internal surfaces of piping and fittings will be representative of the degradation that has occurred on the external surface due to the external treated water environment?

AmerGen Response

The carbon steel piping and fittings listed in LRA Table 3.4.2-8, row 6, on page 3.4-154 includes drain piping for the oil drip pans located at the low pressure turbine bearings. This piping originates at the drip pans and passes through the main condenser. The piping exits the main condenser by passing through the condenser walls and terminates at the turbine bearing drip pan collection drain tanks. These tanks are attached to the external side of the condenser walls.

The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Aging Management Program is typically credited for the inspection of internal surfaces of piping and components that are not included in other aging management programs. In this application, the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Aging Management Program is used to inspect a portion of the drip pan drain piping internal to the main condenser steam space, where the external surfaces of this piping are subject to erosion. This aging management program includes inspection of these external piping surfaces for loss of material.

The external surfaces of the drip pan drain piping are also subject to loss of material due to general, pitting, and crevice corrosion. The Water Chemistry and One-Time Inspection Programs are credited for managing these aging effects.

RAI#: 3.6-1

LRA Section: 3.6, Aging Management of Electrical Commodity Groups

Background:

The GALL Report, Item VI.A-8 identifies corrosion as one of the aging effects/mechanisms for fuse holders (metallic clamp) that requires an AMP (GALL Report XI.E5).

Issue:

On page 3.6-10 of the LRA in section 3.6.2.3.1, it is stated that fuse holders are located in a controlled environment and are not subject to corrosion. During the on-site audit, the staff reviewed Issue Report (IR) 00461358, which described a root cause of a control circuit failure in a controlled environment due to a corroded fuse holder clip.

Request:

Explain why oxidation is not an aging effect requiring management for fuse holders when plant specific operating experience has shown that oxidation is a potential aging effect in the same environmental condition.

AmerGen Response

Oxidation is not considered an aging effect requiring management for fuse holders. The final Apparent Cause Evaluation (ACE) for TMI-1 Issue Report 00461358 determined that this control circuit failure was the result of distortion of the removable fuse clips. This ACE includes laboratory analysis on a sampling of fuse/fuse block assemblies, which included the trip and close fuses/fuse block assemblies that were the initiators of this failure. These fuse/fuse block assemblies are configured with a removable fuse clip. It was determined by the laboratory analysis performed in support of the ACE that circumferential distortion of the removable fuse clip around the ferrule and the compression set of stabs, and the wearing of the stab spring wipe protrusion due to use caused a poor electrical connection. The laboratory analysis determined that what was initially thought to be the cause of the control circuit failure (i.e., corrosion), was incorrect. The green material found on fuse holder stabs, which can be an indication of corrosion, was determined to be electrical grease. There was no evidence of corrosion products.

IR 00461358 addresses fuses/fuse block assemblies that are part of a larger assembly. These fuses/fuse block assemblies, per NUREG 1801, Volume 2, Table VI, Electrical Components, Line Items VI.A-6 and VI.A-7, are not included in the aging management review for fuse holders. The aging management review as presented in the TMI-1 LRA for in scope fuse holders at TMI-1 is not impacted by IR 00461358. The in-scope fuse holders are not subject to environmental aging mechanisms. The in-scope fuse holders are not subject to fatigue, mechanical stresses or manipulation.

RAI#: 3.6-2

LRA Section: 3.6, Aging Management of Electrical Commodity Groups

Background:

On page 3.6-9 of the LRA in section 3.6.2.2.3, it is stated that tests performed by Ontario Hydroelectric showed a 30% loss of composite conductor strength (over time) of an 80-year-old aluminum conductor steel reinforced (ACSR) conductor due to corrosion. It is further stated that the Ontario Hydroelectric study is considered to bound the TMI-1 configuration.

Issue:

It is not clear how the Ontario Hydroelectric test was conducted. It is not clear how the TMI-1 transmission conductor configuration is bounded by these tests and if the configuration will have adequate margin for 60 years.

Request:

1. Describe in detail how the test conducted at Ontario Hydroelectric was performed.

2. Explain how the TMI-1 transmission conductor configuration is bounded by the tests performed at Ontario Hydroelectric and how the conductor configuration will have adequate margin for 60 years?

AmerGen Response

1. The Ontario Hydroelectric Study is documented in two parts in IEEE Transactions on Power Delivery, Volume 7, Number 2, April 1992©. The papers present the methodology and results of both field and laboratory tests on ACSR (aluminum conductor steel reinforced) conductors from Ontario Hydroelectric's older transmission lines. The field tests were performed on-line, to detect steel core galvanizing loss by using an overhead line conductor corrosion detector. Potential conductor degradation is measured by an eddy current sensor that travels along the conductor, between transmission towers. Laboratory tests were performed for fatigue, tensile strength, torsional ductility, and electrical performance. The fatigue tests simulating 50 years of service life were performed to assess existing cables as well as a new cable. The tensile strength was assessed by the individual wire method, and torsional ductility was assessed by the twist to failure method. Both the tensile strength and torsional ductility tests were performed in accordance with published standards. Additional considerations in the performance of these aging assessments included metallurgical data and analysis for potential environmental contributors.

2. The in-scope TMI-1 transmission conductors are bounded by the Ontario Hydroelectric study by test methodology, design and construction, installation, and environment and have an ultimate strength margin greater than the Ontario Hydroelectric test cables after 80 years of service. The in scope transmission conductors at TMI-1 connect the auxiliary transformers to the switchyard. The TMI-1 transmission conductors are 795 MCM 26/7 ACSR. This is the same type of transmission conductors evaluated in the Ontario Hydroelectric study. It is also the same type of transmission conductor that was compared to the analysis of the Ontario Hydroelectric Study in the EPRI License

Renewal Electrical Handbook (1013475). Therefore, the test methodology as published in the IEEE Transactions on Power Delivery is applicable to TMI-1 transmission conductors.

The EPRI License Renewal Electrical Handbook evaluation documents that a 4/0 ACSR conductor (equivalent to a 211 MCM conductor size), which was included in the Ontario Hydroelectric study, has the smallest ultimate strength margin. Larger, more substantial transmission conductors (e.g., 336.4 MCM 30/7 conductors) that had a greater strength margin were bounded by the 4/0 6/1 ACSR conductor example. The TMI-1 795 MCM 26/7 ACSR transmission conductor is approximately 1 inch in diameter and is configured with 7 steel conductors wrapped by 26 aluminum conductors versus the 4/0 6/1 ACSR conductor which is approximately ½ inch in diameter with a single steel conductor wrapped by six aluminum conductors. The rated or ultimate strength per ASTM standards for the 795 26/7 ACSR conductor is 31,500 lbs while the rated strength for the 4/0 6/1 ACSR conductor is 8,350 lbs. Therefore the physical construction of the TMI-1 in scope transmission conductors' strength margin is bounded by the handbook analysis of the 4/0 ACSR conductor and is also bounded by the Ontario Hydroelectric study.

The NESC (National Electric Safety Code) design parameter of using a maximum final tension of 60% of the ultimate strength is based on typical transmission conductor spans. The TMI-1 in scope transmission conductors are installed in relatively short spans (e.g., 125 feet and 325 feet) compared to typical transmission conductor spans (1,000 to 1,500 feet), so the NESC (National Electric Safety Code) parameters for ACSR conductors is conservative for the TMI-1 installed ACSR conductors. The shorter spans reduce the physical strain on the conductors as installed and when subject to ice, snow and wind conditions; therefore, the physical installation of the in scope TMI-1 transmission conductors is very conservative and bounded by the NESC.

TMI-1 is located in an area where industrial airborne particle concentrations are comparatively low, since it is not located in a heavily industrialized area. In the Ontario Hydroelectric Study, the conductors most affected by atmospheric corrosion were located in areas subject to pollution sources and a major urban area. TMI-1 transmission conductors (which are located in a rural area) are bounded by the Ontario Hydroelectric conductors (which are located in polluted and urban environments).

RAI#: 3.6-3

LRA Section: 3.6, Aging Management of Electrical Commodity Groups

Background:

On page 3.6-10 of the LRA in section 3.6.2.2.3 it is stated that the transmission conductor bolted connections are designed and installed using lock and Belleville washers that provide vibration absorption and prevent loss of preload.

Issue:

Electric Power Research Institute (EPRI) document TR-104213, "Bolted Joint Maintenance & Application Guide," identifies a special problem with Belleville washers. It states that hydrogen embrittlement is a recurring problem with Belleville washers and other springs. When springs are electroplated, the plating process forces hydrogen into the metal grain boundaries. If the hydrogen is not removed, the spring may spontaneously fail at any time while in service.

Request:

1. Are electroplated Belleville washers currently in use at TMI-1?

2. Describe any current activity used to confirm the effectiveness of switchyard bolted connections that will be used in the period of extended operation to prevent this aging effect.

AmerGen Response

1. Electroplated Belleville washers are not in use in TMI-1 switchyard connections. Typical connections for the TMI-1 switchyard are composed of a flat washer and a lock washer. A visual inspection of at least 50% of the switchyard connections that are in scope for license renewal did not identify any installed Belleville washers in transmission and switchyard bus connections. TMI-1 Bill of Materials for switchyard bus, insulators and fittings identify the material for the lock washers as galvanized steel. Additionally, there is no documented failure of a switchyard connection due to hydrogen embrittlement of a locking washer at TMI-1.

2. Per the Further Evaluation discussion in the TMI-1 LRA, section 3.6.2.2.3, there are no aging effects for transmission conductor connections and switchyard bus connections that require an aging management program. Even though there is no aging effect requiring management, TMI-1 switchyard connections are currently surveyed as part of preventive maintenance by TMI-1 personnel, via thermography, at a minimum of every six months in accordance with procedures and best preventive maintenance practices. Additionally, the Transmission System Owner performs yearly thermography. Themography is a proven methodology for detecting deterioration of connections and devices prior to failure.