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W3F1-2017-0006

February 23, 2017

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

SUBJECT: Responses to Request for Additional Information Set 12 Regarding the License Renewal Application for Waterford Steam Electric Station, Unit 3 (Waterford 3)
Docket No. 50-382
License No. NPF-38

REFERENCES:

1. Entergy letter W3F1-2016-0012 "License Renewal Application, Waterford Steam Electric Station, Unit 3" dated March 23, 2016.
2. NRC letter to Entergy "Requests for Additional Information for the Review of the Waterford Steam Electric Station, Unit 3, License Renewal Application – Set 12" dated January 26, 2017.
3. Entergy letter W3F1-2016-0071 "Responses to Request for Additional Information Set 4 Regarding the License Renewal Application for Waterford Steam Electric Station, Unit 3" dated January 9, 2017.

Dear Sir or Madam:

By letter dated March 23, 2016, Entergy Operations, Inc. (Entergy) submitted a license renewal application (Reference 1).

In letter dated January 26, 2017 (Reference 2), the NRC staff made a Request for Additional Information (RAI) Set 12, needed to complete its review. Enclosure 1 provides the responses to the Set 12 RAIs. Enclosure 2 contains a revised response to RAI 1.38-1 which supersedes the response originally provided in Reference 3.

There are no new regulatory commitments contained in this submittal. If you require additional information, please contact the Regulatory Assurance Manager, John Jarrell, at 504-739-6685.

I declare under penalty of perjury that the foregoing is true and correct. Executed on February 23, 2017.

Sincerely,

MRC/AJH

Enclosures: 1. Set 12 RAI Responses – Waterford 3 License Renewal Application
2. RAI B.1.38-1 Revised Response

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Enclosure 1 to

W3F1-2017-0006

Set 12 RAI Responses
Waterford 3 License Renewal Application

RAI B.1.36-1a

Background:

The initial response to RAI B.1.36-1 did not provide sufficient bases to establish that flow blockage for the wet cooling tower (WCT) distribution nozzles does not need to be managed in the auxiliary component cooling water (ACC) system.

Issue:

1. LRA Table 2.3.3-3 lists “nozzle” as a component type in the ACC system but only includes “pressure boundary” as the intended function. The design basis document for this system (W3-DBD-4, Section 3.2.2.2) identifies these WCT components as “spray nozzles,” indicating that they may have additional intended functions.

2. The RAI response states that flow restriction may be an issue for spray nozzles, but states this is not considered an age-related effect and flow blockage is not an aging effect requiring management for the WCT distribution nozzles. The staff notes that biofouling of the component cooling water heat exchanger was previously identified in LER 382/1994-004, demonstrating that fouling within the ACC system has occurred. In addition, the ACC design basis document DBD-4, Section 3.2.2.2.F identifies that the original Munters spray nozzles were changed to the current Bete fog nozzles sometime afterwards. It is unclear to the staff whether the spray nozzle change was related to past operating experience issues associated with fouling or blockage.

Request:

1. Clarify the intended functions of the nozzles in the WCT. Specifically address whether these nozzles have an intended function associated with “flow control” or “flow distribution” (as defined in LRA Table 2.0-1, “Component Intended Functions…”). If an intended function different than that stated in the LRA is identified, appropriately update the LRA and discuss how any aging effects that can adversely affect the intended function will be managed. If the intended function is only “pressure boundary,” provide details from the design basis information to show that the current licensing basis heat transfer will be met assuming straight flow out of the associated piping (i.e., no credit for spray or flow distribution).

2. If flow blockage will not be managed for the spray nozzles, provide additional information regarding the absence of nozzle fouling or blockage from recent inspection results.

   a. address the potential for different results in the future, since aging effects for the galvanized coating on the WCT distribution piping (per FSAR Table 9.2-8) are not being managed (per WF3-ME-14-00030) and consequently may not effectively limit internal corrosion like it has in the past.

b. provide sufficient details (isometric drawings or equivalent sketches) for the WCT distribution piping to show that all piping segments will appropriately drain, such that internal corrosion, which could promote flow blockage (similar to that discussed in Information Notice 2013-06) is not likely.

c. address the periodic wetting and drying aspect to show that accelerated corrosion (similar to that discussed in SRP-LR Section 3.2.2.2.5) is not likely.

d. explain why the original Munters spray nozzles were changed to the current Bete fog nozzles (per W3-DBD-4, Section 3.2.2.2.F) and if this change is related to past operating experience issues associated with fouling or blockage.

Waterford 3 Response

1. The wet cooling tower nozzles provide a pressure boundary and flow distribution function. The cooling tower nozzles are designed to be clog resistant and tolerant of large particulates. An intended function of flow control is added for these nozzles. The LRA is updated to reflect the addition of the flow control intended function and to indicate how loss of material that could result in flow blockage of these nozzles will be managed.
2. Loss of material that could result in flow blockage of the wet cooling tower nozzles will be managed.

LRA Changes

The LRA Tables 2.3.3-3, 3.3.1, and 3.3.2-3 and Sections A.1.30 and B.1.30 are revised as shown below. Additions are shown with underline.

Table 2.3.3-3
Component Cooling and Auxiliary Component Cooling Water Systems
Components Subject to Aging Management Review

Component Type	Intended Function
Nozzle	Flow control Pressure boundary

Table 3.3.1: Auxiliary Systems					
Item Number	**Component**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.3.1-40	Stainless steel piping, piping components, and piping elements exposed to raw water	Loss of material due to pitting and crevice corrosion; fouling that leads to corrosion	Chapter XI.M20, "Open-Cycle Cooling Water System"	No	~~Consistent with NUREG-1801.~~ Loss of material for stainless steel components exposed to raw water is managed by the Service Water Integrity Program. The Periodic Surveillance and Preventive Maintenance Program manages loss of material that could result in flow blockage for the wet cooling tower nozzles using periodic visual inspections.

Table 3.3.2-3: Component Cooling and Auxiliary Component Cooling Water System								
Component Type	**Intended Function**	**Material**	**Environment**	**Aging Effect Requiring Management**	**Aging Management Programs**	**NUREG-1801 Item**	**Table 1 Item**	**Notes**
Nozzle	Flow Control Pressure boundary	Stainless steel	Air – outdoor (ext)	Cracking	External Surfaces Monitoring	VII.C1.AP-209	3.3.1-4	A
Nozzle	Flow Control Pressure boundary	Stainless steel	Air – outdoor (ext)	Loss of material	External Surfaces Monitoring	VII.C1.AP-221	3.3.1-6	A
Nozzle	Flow Control Pressure boundary	Stainless steel	Raw water (int)	Loss of material	Service Water Integrity	VII.C1.A-54	3.3.1-40	A
Nozzle	Flow Control Pressure boundary	Stainless steel	Raw water (int)	Loss of material	Periodic Surveillance and Preventive Maintenance	VII.C1.A-54	3.3.1-40	E

A.1.30 Periodic Surveillance and Preventive Maintenance Program

Credit for program activities has been taken in the aging management review of the following systems and structures.

Inspect the wet cooling tower nozzles

B.1.30 Periodic Surveillance and Preventive Maintenance

Program Description

Credit for program activities has been taken in the aging management review of systems, structures and components as described below.

System	Inspection
Component cooling and auxiliary component cooling water system	Use visual or other NDE techniques to inspect a representative sample of the tubes and fins of the CCW dry cooling tower radiator to manage fouling that could result in a reduction of heat transfer capability. Perform a visual inspection of the internal surface of the portable UHS replenishment pump casing to manage loss of material. Perform a visual inspection of the wet cooling tower nozzles to manage loss of material that could result in flow blockage of the nozzles.

3. Parameters Monitored/Inspected

For selected metallic piping components, wall thickness is measured to determine the extent of corrosion caused by recurring internal corrosion mechanisms. For reinforced concrete piping, visual inspections monitor the condition of the internal surface. For wet cooling tower nozzles, visual inspections identify flow blockage.

RAI B.1.36-2a

Background:

The response to RAI B.1.36-2 states that the siphon-breaker holes in the nonsafety-related chemical addition and filtration (CA&F) system were appropriately excluded from the scope of license renewal. The response credits basin level indications and alarms to alert the plant staff, allowing them to take corrective actions to address a failure in the CA&F system that was siphoning water out of the safety-related wet cooling tower (WCT) basins. The staff notes that during some design basis events, WCT basin levels will (by design) drop below the basin alarm levels, and basin level indications will show decreasing values due to evaporation, etc. (per water requirements in UFSAR Table 9.2-10). Consequently, the plant staff would not be aware that a failure in CA&F system was siphoning water out of the basins in all circumstances.

Issue:

The staff considers that the functional separation/isolation of the nonsafety-related CA&F system relies on the passive function of the siphon-breaker holes. In addition, it is unclear to the staff why other components in the CA&F system that are either within or above the WCT basin can be excluded from the scope of license renewal.
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Request:

1. For all of the CA&F components that are either within or above the WCT basin, provide information to show that their failure due to aging effects cannot prevent satisfactory accomplishment of an ACC intended function. Specifically address the flex hoses between the piping and the suction manifolds and any supports or attachments that stabilize any of the CA&F components. Alternatively, include the portions of the CA&F system within the scope of license renewal and update the LRA (including demonstration that the effects of aging will be adequately managed so that the intended functions will be maintained).

2. For the siphon-breaker holes in the CA&F suction piping, provide design basis documentation showing that a failure of the CA&F system could not prevent satisfactory accomplishment of an intended function for the ACCW system. Alternatively, include the siphon-breaker holes of the CA&F system within the scope of license renewal and update the LRA (including demonstration that the effects of aging will be adequately managed so that the intended functions will be maintained).

Waterford 3 Response

1. The portions of the chemical addition and filtration (CA&F) system that are either within or above the wet cooling tower (WCT) basin comprise piping, flex hoses, and valve bodies. Supports for the piping components are included as commodities in the structural portion of the Waterford 3 license renewal application (LRA). The Structures Monitoring Program manages the effects of aging on nonsafety-related piping supports. As described in NEI 95-10, Section 5.2.2.3, as long as the effects of aging on nonsafety-related pipe supports are managed, falling of piping sections during a seismic event is not considered credible. This consideration is applied to the CA&F piping components in the WCT basin to conclude that the piping will remain in place and not impact the function of safety-related SSCs. Therefore, the piping performs no license renewal intended function associated with 10 CFR 54.4(a)(2) through physical contact with safety-related systems, structures or components. With respect to spatial interaction, the piping performs no license renewal intended function associated with 10 CFR 54.4(a)(2) because it is in an outdoor environment where safety-related components are not susceptible to the effects of aging caused by spatial interaction. Because a flex hose is not a typical rigid piping component, the LRA is revised to indicate that the effects of aging will be managed for the flex hoses.

2. The CA&F system piping segments with the siphon breaker holes are subject to aging management review. The LRA is revised to indicate that the effects of aging will be managed so that the flow control intended function associated with the siphon breaker holes will be maintained.

The LRA Tables 2.3.3-3, 3.3.1, and 3.3.2-3 and Sections A.1.30 and B.1.30 are revised as shown below. Additions are underlined.

Table 2.3.3-3
Component Cooling and Auxiliary Component Cooling Water Systems
Components Subject to Aging Management Review

Component Type	Intended Function
Flex hose	Pressure Boundary
Piping	Flow Control Pressure boundary

Table 3.3.1: Auxiliary Systems					
Item Number	**Component**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.3.1-134	Steel, stainless steel, or copper alloy piping, piping components, and piping elements, and heat exchanger components exposed to a raw water environment (for nonsafety-related components not covered by NRC GL 89-13)	Loss of material due to general (steel and copper alloy only), pitting, crevice, and microbiologically influenced corrosion, fouling that leads to corrosion	Chapter XI.MI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	Consistent with NUREG-1801 for most components. Loss of material for nonsafety-related steel, stainless steel and copper alloy components exposed to raw water (not covered by NRC GL 89-13) is managed by the Internal Surfaces In Miscellaneous Piping And Ducting Components Program. The Periodic Surveillance and Preventive Maintenance Program manages loss of material in copper alloy piping of the component cooling and auxiliary component cooling water system using periodic visual inspections.

Table 3.3.2-3: Component Cooling and Auxiliary Component Cooling Water System								
Component Type	**Intended Function**	**Material**	**Environment**	**Aging Effect Requiring Management**	**Aging Management Programs**	**NUREG-1801 Item**	**Table 1 Item**	**Notes**
Flex hose	Pressure boundary	EPDM	Raw water (int)	None	None	--	--	F
Flex hose	Pressure boundary	EPDM	Raw water (ext)	None	None	--	--	F
Piping	Flow control	Copper alloy	Raw water (int)	Loss of material	Periodic Surveillance and Preventive Maintenance	VII.C1.A-408	3.3.1-134	E
Piping	Flow control	Copper alloy	Raw water (ext)	Loss of material	Periodic Surveillance and Preventive Maintenance	VII.C1.A-408	3.3.1-134	E

A.1.30 Periodic Surveillance and Preventive Maintenance Program

Credit for program activities has been taken in the aging management review of the following systems and structures.

- Inspect wet cooling tower chemical addition and filtration system suction piping anti-siphon holes.

B.1.30 Periodic Surveillance and Preventive Maintenance

Credit for program activities has been taken in the aging management review of systems, structures and components as described below.

System	Inspection
Component cooling and auxiliary component cooling water system	Use visual or other NDE techniques to inspect a representative sample of the tubes and fins of the CCW dry cooling tower radiator to manage fouling that could result in a reduction of heat transfer capability. Perform a visual inspection of the internal surface of the portable UHS replenishment pump casing to manage loss of material. Perform a visual inspection of the wet cooling tower chemical addition and filtration system suction piping anti-siphon holes to manage loss of material that could result in flow blockage.

RAI B.1.36-6a

Background:

The response to RAI B.1.36-6 states that WF3-EP-14-00010, (AMRS report) reconciles and summarizes the results from WF3-ME-14-00009 (system AMR report for component cooling and auxiliary component cooling) and the WF-ME-00030 (topical AMR report for coatings). The response concludes that AMR items in LRA Table 3.3.2-3 are consistent with the relevant basis documents.

The AMR Summary report Section 1.2 s tates:

> "*The AMRR results are unchanged [emphasis added] in the AMRS with the following possible exceptions.*
>
> *Minor editorial changes, with no effect on the results, may be made to assure consistent use of terminology and report format. For example, words abbreviated in the AMRR may be spelled out, capitalization may be changed and in some cases the order of results presentation may be revised for consistency.*
>
> *For AMRRs developed as topical reports, such as AMRR for corrosion under insulation, the AMRR results will be incorporated into the AMRS tables in a manner that best presents the information. For example, lines from the topical report AMRR may be added to the individual system tables in the AMRS [emphasis added].*

Issue:

The AMR Summary report does not reflect the statements in the RAI response "the AMRS report reconciles [emphasis added] and summarizes the results" of the system AMR reports and the topical AMR reports. Although lines from the topical AMR report may be added to the system tables in the AMRS, (thus explaining why additional items may appear in the AMR summary tables), an explanation for the lines that have been deleted from the system AMR tables in the AMR summary tables is not provided in the basis documentation. The deletion of lines from the system AMR tables is inconsistent with the statement in the AMR Summary report that "the AMRR results are unchanged in the AMRS…"

Request:

Provide an explanation for why line items have been deleted from the tables in WF3-ME-14-00009, "Aging Management Review of the Component Cooling and Auxiliary Component Cooling Water Systems," as discussed in the initial request and explain how, if not updated, the relevant basis documentation will meet the record retention requirements of 10 CFR 54.37(a).

Waterford 3 Response

WF3-ME-14-00009, Revision 1, "Aging Management Review of the Component Cooling and Auxiliary Component Cooling Water Systems," provides the aging management review results for the component cooling and auxiliary component cooling water systems. A separate topical aging management review report provides aging management review results for components with internal coating or lining. WF3-EP-14-00010, Revision 0, "Aging Management Review Summary," the AMRS report, reconciles and summarizes the results from system aging management review reports, such as WF3-ME-14-00009, and from aging management review topical reports, such as the WF3 license

renewal topical report on coating integrity. For components such as carbon steel piping, the system aging management review report identifies carbon steel piping exposed to raw water internal and identifies an appropriate aging management program. The topical report on coating integrity identifies that this piping has an internal coating. The AMRS report modifies the piping line item that was shown as carbon steel piping to indicate that it is carbon steel with internal coating and that the Coating Integrity Program manages the effects of aging. This is the typical approach when developing the AMRS tables. The AMRS report is the basis document for the WF3 LRA tables. WF3 LRA tables are, therefore, consistent with the relevant basis document.

The reference in the Issue section of the RAI regarding the statement in the AMR Summary report that “the AMRR results are unchanged in the AMRS…” is lacking context. As noted under Background of the RAI, incorporation of the results of a topical aging management review report is an exception for which the AMRR results are changed. For additional clarification, WF3-EP-14-00010, “Aging Management Review Summary,” will be revised to include an example of incorporation of information from a coating topical report that results in modifying a line from a system AMR report. The example will be a change in material for a piping component type from “Carbon steel” to “Carbon steel with internal coating.” In such a case, the component type, intended function and environment would remain unchanged. The remaining columns would be revised as appropriate based on the material being “Carbon steel with internal coating.”

RAI 3.5.1.74-1a

Background:

Section 54.21(a)(3) of Title 10 of the Code of Federal Regulations (10 CFR) requires applicants to demonstrate that the effects of aging for systems, structures, and components (SSCs) within the scope of license renewal and subject to an aging management review (AMR) pursuant to 10 CFR 54.21(a)(1) will be adequately managed so that intended function(s) will be maintained consistent with the current licensing basis (CLB) for the period of extended operation. The SRP-LR states that the identification of applicable aging effects based on materials, environment, and operating experience should be provided in the license renewal application (LRA) to demonstrate that the requirements of 10 CFR 54.21(a)(3) are met. The LRA Table 2 AMR items provide the detailed identification of AMRs.

In its response to RAI 3.5.1.74-1, provided by letter dated December 7, 2016, the applicant stated that Waterford 3 has not identified Lubrite® sliding surfaces that are applicable to SRP-LR AMR item 3.5.1-74, but did state that "Waterford 3 does have Lubrite® plates associated with the reactor coolant system [RCS] that are addressed in LRA Table 3.5.1, [i]tem 75."

LRA Table 3.5.1, AMR item 3.5.1-75 states, in part, that "[l]oss of material which could cause loss of mechanical function is addressed under [i]tem 3.5.1-77 related to component support members." LRA Table 3.5.1, AMR item 3.5.1-77 states that the Structures Monitoring Program manages the listed aging effects.

Issue:

The staff notes that for SRP-LR AMR item 3.5.1-75 the Generic Aging Lessons Learned (GALL) Report recommends GALL Report aging management program (AMP) XI.S3, "ASME Section XI, Subsection IWF," to manage the potential aging effects of Class 1, 2, and 3 sliding support surfaces made of Lubrite®; graphitic tool steel, fluorogold, and lubrofluor. GALL Report AMP XI.S3 contains recommendations that are not included in the Structures Monitoring Program. Examples of GALL Report AMP XI.S3 recommendations include, but are not limited to, the following:

- GALL Report AMP XI.S3 states that the American Society of Mechanical Engineers (ASME) Code requires that a sample of ASME Class 1, 2, and 3 piping supports and supports other than piping supports (Class 1, 2, 3, and metal containment) that are not exempt from examination be examined as specified in Table IWF-2500-1, "Examination Categories."
- GALL Report AMP XI.S3 includes acceptance criteria for sliding surfaces that identifies arc strikes, weld spatter, paint, scoring, roughness, or general corrosion on sliding surfaces as unacceptable conditions.
- The "corrective actions" program element states that identification of unacceptable conditions triggers an expansion of the inspection scope, in accordance with IWF-2430, and reexamination of the supports requiring corrective actions during the next inspection period, in accordance with IWF-2420(b). In accordance with IWF-3122, supports containing unacceptable conditions are evaluated or tested or corrected before returning to service.

The staff notes that the applicant's Structures Monitoring Program does not include several of the above and other GALL Report recommendations for age management of the identified RCS supports with Lubrite® sliding surfaces. In addition, the staff notes that there are no LRA Table 2 AMR items identifying Lubrite® as a material for sliding surfaces of component supports that would be subject to AMR. Based on its review of the applicant's response, the LRA Structures Monitoring Program, and LRA AMR tables, it is not clear whether the Lubrite® plates in the RCS are component supports applicable to the GALL Report AMP XI.S3 recommendations and, if so, whether the Structures Monitoring Program will incorporate the recommendations of GALL Report AMP XI.S3 for these components. In addition it is not clear how the criteria in 10 CFR 54.21(a)(3) and SRP-LR is being met absent the identification of Lubrite® as a material subject to AMR in the LRA Table 2 AMR items.

Request:

1. State whether the Lubrite® plates are ASME Code Class 1, 2, and/or 3 supports and, if so, state how the aging effects will be managed under the Structure Monitoring Program consistent with the above recommendations from the GALL Report AMP XI.S3. Provide a technical basis if recommendations from GALL Report AMP XI.S3 will not be addressed by the Structures Monitoring Program to manage the aging effects of these components.

2. For those components with Lubrite® plates for which the aging effects will be managed, state how the criteria of 10 CFR 54.21(a)(3) will be met without identifying Lubrite® as a material in the Table 2 AMR items.

Waterford 3 Response

1. Although Entergy has identified no aging effects requiring management for Lubrite® sliding surfaces, ASME Code Class 1, 2, or 3 supports that incorporate the use of Lubrite® sliding surfaces are inspected under the Inservice Inspection-IWF Program. These component supports are addressed in license renewal application (LRA) Table 3.5.1, Item 75. To clarify how the aging effects associated with license renewal application (LRA) Table 3.5.1, Item 75 (and corresponding GALL Report AMR items) will be adequately managed during the period of extended operation, the discussion in Waterford 3 (WF3) LRA Table 3.5.1, Item 75, is revised to indicate that the In-service Inspection-IWF Program manages the effects of aging on sliding surfaces.

2. Lubrite® sliding surfaces, where provided, are integral to the supports and are therefore included in the inspection of those supports. Because Lubrite® sliding surfaces are integral to the supports no individual line item is provided in the LRA tables. However for clarification, as stated in Response 1 above, the corresponding line item is revised.

   LRA revisions are as follows. Additions are shown with underline and deletions with strikethrough.

Table 3.5.1: Structures and Component Supports

Item Number	Component	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
3.5.1-75	Sliding surfaces	Loss of mechanical function due to corrosion, distortion, dirt, debris, overload, wear	ISI (IWF)	No	NUREG-1801 item referencing this item is associated with Lubrite® plates. Lubrite® plates are not subject to aging management because the listed aging mechanisms are event driven and typically can be avoided though proper design. Loss of material which could cause loss of mechanical function is addressed under ~~Item 3.5.1-77~~ items 3.5.1-57 and 3.5.1-91 related to component support members.

RAI B.1.1-3a

Background:

Section 54.21(a)(3) of Title 10 of the Code of Federal Regulations (10 CFR) requires applicants to demonstrate that the effects of aging for systems, structures, and components (SSCs) within the scope of license renewal and subject to an aging management review (AMR) pursuant to 10 CFR 54.21(a)(1) will be adequately managed so that intended function(s) will be maintained consistent with the current licensing basis (CLB) for the period of extended operation.

The "detection of aging effects" program element of GALL Report AMP XI.M18 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. Periodic inspection of pressure boundary components for signs of leakage ensures that age-related degradation of closure bolting is detected and corrected before component leakage becomes excessive. The staff noted that it is difficult to visually detect leakage of clear gaseous fluids and the GALL Report AMP XI.M18 does not provide specific guidance for the detection of leakage of clear gaseous fluids from a bolted connection. Therefore, by letter dated November 15, 2016, the staff issued RAI B.1.1-3 requesting that the applicant state how signs of leakage of clear gaseous fluids will be detected from bolted closures included in the Bolting Integrity Program in order to ensure the detection of loss of material and loss of preload before there is a loss of intended function. In its response to RAI B.1.1-3, provided by letter dated December 15, 2016, the applicant stated, in part, that:

> [e]ffectively, bolted closures on fluid-containing systems would represent a sample of the overall bolted closure population, including bolted closures in gas-filled systems. […] [P]ersonnel can identify leakage from bolted closures through visual and audible indications. Visual indications can include residue on nearby components and, in the case of steam systems, a visible plume or condensation in the area of the leak. Audible indications that could indicate a leak are the sounds of leaking gaseous contents escaping from the system. In addition, system engineers review operations logs, deficiency lists, and system parameters such as pressure, flow, and temperature which could indicate a system leak. Based on these activities and considerations, signs of leakage of clear gaseous fluids are detected from bolted closures included in the Bolting Integrity Program, and ensure that the detection of loss of material and loss of preload occur before there is a loss of intended function.

Issue:

The LRA states that the applicant's Bolting Integrity Program is consistent with GALL Report AMP XI.M18. The staff notes that the GALL Report AMP XI.M18 is not a sampling-based program and that the program relies on periodic inspections of all closure bolts within the scope of license renewal. From the applicant's statement that "fluid-containing systems would represent a sample of the overall bolted closure population, including bolted closures in gas-filled systems," it is not clear whether the applicant plans to use closure bolt degradation in fluid-filled systems as a leading indicator for degradation of closure bolting for gas-filled systems, and potentially not inspect all closure bolting as recommended by the GALL Report.

The staff notes that for systems with gaseous fluids such as air it is unlikely that a leakage could be identified through a visual inspection and that it is also unlikely that such leakage may leave residue on nearby components that would be identifiable by a visual inspection. The staff also notes that although identification of leakage is possible through audible indications this method may not be effective for systems in areas where there is a high level of noise and also due to common requirements for the use of ear protection in those areas. Furthermore it is not clear whether all systems with gaseous fluids are subject to a review of operations logs, deficiency lists, and parameters such as pressure, flow, and temperature which could indicate a system leak. Therefore for each system with air it is not clear what method or combination of methods applies and how such method(s) would be effective to identify air leakage and ensure the detection of loss of material and loss of preload before there is a loss of intended function.

Request:

1. State whether the inspections of closure bolts under the Bolting Integrity Program will include all closure bolts in-scope of the program or if only a sample will be inspected. If an exception is taken to the GALL Report AMP XI.M18 recommendation that all in-scope closure bolting be inspected for signs of leakage to indicate loss of material and loss of preload, provide the technical basis to demonstrate that the program will adequately ensure the detection of age-related degradation before there is a loss of intended function.

2. List those systems in-scope of license renewal that contain gaseous fluids for which aging effects will be managed by the Bolting Integrity Program. For each of the systems listed state how signs of leakage of clear gaseous fluids will be detected on associated closure bolting in order 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.

Waterford 3 Response

1. As stated in LRA Appendix B.1.1, the Bolting Integrity Program, with one exception, will be consistent with the program described in NUREG-1801, Section XI.M18, Bolting Integrity. The Bolting Integrity Program includes all closure bolts as described in the license renewal application (LRA). The Bolting Integrity Program does not employ a sampling approach.

2. WF3 agrees that NUREG-1801 XI.M18 specifies only visual inspection for the detection of leakage of bolted connections, including bolted connections in systems with clear gaseous fluids. Consistent with NUREG-1801, Section XI.M18, the Waterford 3 Bolting Integrity Program includes periodic inspections and preventive measures that are based on the guidance of industry documents including NUREG-1339, EPRI NP-5769, and EPRI TR-104213.

Proper joint preparation and make-up in accordance with industry standards is expected to preclude loss of preload. The review of WF3 OE did not identify instances in which non-Class 1 mechanical components became unable to perform license renewal intended functions due to loss of pressure boundary bolting preload.

Nevertheless, the Bolting Integrity Program includes provisions to manage loss of preload, primarily in the form of preventive measures, which include material selection (e.g., use of materials with an actual yield strength of less than 150 kilo-pounds per square inch [ksi]), lubricant selection (i.e., restricting the use of molybdenum disulfide), applying the appropriate preload (torque), and checking for uniformity of gasket compression, where appropriate, to preclude loss of preload, loss of material, and cracking.

In addition to preventive measures to preclude aging effects that could result in leakage, the program provides for identification of leakage from bolted closures included in the Bolting Integrity Program during periodic inspections conducted during system walkdowns. Other plant personnel may also identify leakage during routine maintenance and operational activities. During these inspections and during routine operational activities, personnel can identify leakage from bolted closures through visual and audible indications. Visual indications can include residue on nearby components and, in the case of steam systems, a visible plume or condensation in the area of the leak. Audible indications that could indicate a leak are the sounds of leaking gaseous contents escaping from the system. In addition, system engineers review operations logs, deficiency lists, and system parameters such as pressure, flow, and temperature that could indicate a system leak. Low compressed air or nitrogen pressure could indicate leakage through a bolted connection. Compressed air and nitrogen systems are monitored for pressure locally and in the main control room.

Although leakage, if it occurs, may not be readily apparent from bolted closures serving some systems containing gaseous material, Waterford 3 operating experience demonstrates that the combination of preventive actions, visual inspections and observations during routine operational activities has been effective at managing the effects of aging on closure bolting. Specifically, the review of Waterford 3 operating experience found no instances in which loss of intended function of a non-Class 1 mechanical component was attributable to loss of pressure boundary bolting preload.

As indicated by review of Waterford 3 operating experience, continuation of the activities specified in the Waterford 3 Bolting Integrity Program provides reasonable assurance that the effects of aging on bolted connections in air and gas systems will be adequately managed so that the pressure boundary intended function will be maintained consistent with the current licensing basis (CLB) for the period of extended operation.

The following systems with bolted connections identified in LRA tables have internal environments of air – indoor (int), air - outdoor (int), condensation (int), or gas (int) and they credit the Bolting Integrity Program.

Systems with Bolted Connections Identified in LRA tables

Table 3.2.2-1: Containment Spray System
Table 3.2.2-2: Safety Injection System
Table 3.2.2-3: Containment Penetrations
Table 3.3.2-1: Chemical and Volume Control System
Table 3.3.2-2: Chilled Water System
Table 3.3.2-3: Component Cooling and Auxiliary Component Cooling Water System
Table 3.3.2-4: Compressed Air System
Table 3.3.2-5: Containment Cooling HVAC System
Table 3.3.2-6: Control Room HVAC System
Table 3.3.2-7: Emergency Diesel Generator System
Table 3.3.2-8: Fire Protection – Water System
Table 3.3.2-9: Fire Protection RCP Oil Collection System
Table 3.3.2-11: Nitrogen System
Table 3.3.2-12: Miscellaneous HVAC Systems
Table 3.3.2-13: Auxiliary Diesel Generator System
Table 3.3.2-14: Plant Drains
Table 3.3.2-15-3: Annulus Negative Pressure System, Nonsafety-Related Components Affecting Safety-Related Systems
Table 3.3.2-15-13: Containment Atmosphere Purge System, Nonsafety-Related Components Affecting Safety-Related Systems
Table 3.3.2-15-14: Containment Atmosphere Release System, Nonsafety-Related Components Affecting Safety-Related Systems
Table 3.3.2-15-18: Fuel Handling Building HVAC System, Nonsafety-Related Components Affecting Safety-Related Systems
Table 3.3.2-15-20: Gaseous Waste Management System, Nonsafety-Related Components Affecting Safety-Related Systems
Table 3.3.2-15-22: Leak Rate Testing System, Nonsafety-Related Components Affecting Safety-Related Systems
Table 3.3.2-15-24: Nitrogen System, Nonsafety-Related Components Affecting Safety-Related Systems
Table 3.3.2-15-28: Primary Sampling System, Nonsafety-Related Components Affecting Safety-Related Systems
Table 3.3.2-15-29: Radiation Monitoring System, Nonsafety-Related Components Affecting Safety-Related Systems
Table 3.3.2-15-30: Reactor Auxiliary Building HVAC System, Nonsafety-Related Components Affecting Safety-Related Systems
Table 3.3.2-15-31: Reactor Cavity Cooling System, Nonsafety-Related Components Affecting Safety-Related Systems
Table 3.3.2-15-33: Secondary Sampling System, Nonsafety-Related Components Affecting Safety-Related Systems
Table 3.4.2-1: Condensate Makeup and Storage System
Table 3.4.2-5-6: Main Steam System, Nonsafety-Related Components Affecting Safety-Related Systems

Many of these systems are in the scope of license renewal and subject to aging management review only for 10 CFR 54.4(a)(2), that is, for the potential of nonsafety-related components to adversely impact the ability of safety-related equipment to perform its safety functions. Leakage from gas-filled portions of these systems would not be a threat to safety-related systems or components. Those portions of systems would be subject to aging management review because they have a license renewal intended function of structural support. It is not considered credible that bolted closures would experience loss of preload and become unable to fulfill the structural support function without visual indications of bolted connection degradation.

Enclosure 2 to

W3F1-2017-0006

RAI B.1.38-1 Revised Response
Waterford 3 License Renewal Application

RAI B.1.38-1(Revised)

Background:

Section 54.21(a)(3) of 10 CFR requires the applicant to demonstrate that the effects of aging for structures and components will be adequately managed so that the intended function(s) will be maintained consistent with the current licensing basis for the period of extended operation. As described in SRP LR, an applicant may demonstrate compliance with 10 CFR 54.21(a)(3) by referencing the GALL Report and when evaluation of the matter in the GALL Report applies to the plant.

The "parameters monitored or inspected," and "detection of aging effects" program elements of GALL Report AMP XI.S6, "Structures Monitoring," recommends that high strength (actual measured yield strength greater than or equal to 150 ksi) structural bolts in sizes greater than 1 inch in diameter to be monitored for stress corrosion cracking (SCC). The GALL Report also recommends that visual inspections be supplemented with volumetric or surface examinations to detect cracking for this type of bolts.

LRA Section B.1.38, "Structures Monitoring," states that the Structures Monitoring Program is an existing program, with enhancements, that will be consistent with GALL Report AMP XI.S6. The staff notes that LRA Section B.1.38 does not provide an enhancement to the "parameters monitored or inspected," and/or "detection of aging effects" program elements to address the aging effects of SCC in high strength structural bolts. LRA Table 3.5.1, item 68, states, in part, that "since molybdenum disulfide thread lubricants are not used at WF3, for structural bolting applications, SCC of high strength structural bolting is not an aging effect requiring management at WF3."

During the AMP audit, the staff reviewed the applicant's "Aging Management Program Evaluation Report Civil/Structural" (AMPER), implementing procedures, plant structural specifications and drawings, and noted the following:

- The applicant excluded the use of supplemental examinations in high strength structural bolts and states, in part, that "since a thread lubricant containing molybdenum disulfide is not used at WF3, SCC of structural bolting in not plausible, inspections are not required to be supplemented with volumetric or surface examinations." (AMPER Section 3.4.2.b)
- Plant structural specification LOU 1564.723, "Structural Steel Seismic I & II," states, in part, that "field connections shall be friction type joints, assembled with 7/8" diameter high-strength bolts, unless otherwise noted on drawings…"
- Plant drawings notes, in general, stated that "field connections, unless noted, shall be ASTM A325 high strength bolted friction type connections…"
- Structural drawings reviewed by the staff indicates the use of several types of bolts (including A325 and A193 B7 types bolts), and bolts with diameter greater than 1 inch.

Issue:

It is not clear to the staff if "parameters monitored or inspected," and "detection of aging effects" program elements of the Structures Monitoring Program is consistent with the GALL Report recommendation because:

1. The applicant's Structures Monitoring Program does not provide sufficient justification for not managing the aging effects of SCC in high strength structural bolting, because the GALL Report does not credit the molybdenum disulfide thread lubricant as the only contributor to the aging mechanism of SCC in high strength bolts.
2. It is not clear to the staff (1) whether high strength structural bolts greater than 1 inch in diameter are used or not in structural applications, or (2) how supplemental examinations are performed for these bolts because the plant's structural specifications and drawings do not preclude the use of high strength structural bolts with diameter greater than 1 inch when specified or noted as such in the drawing details.

Request:

1. State whether or not there are high-strength structural bolts (actual measured yield strength greater than or equal to 150 ksi) in sizes greater than 1 inch diameter used in structural applications. Note: consider actual bolts being specified in the plant's structural drawing details in addition to generic drawing notes.
2. If high-strength structural bolts (actual measured yield strength greater than or equal to 150 ksi) in sizes greater than 1 inch diameter are used in structural applications, state whether and how the recommendations for managing degradation of high-strength bolts described in the "parameters monitored or inspected," and "detection of aging effects" of the GALL Report AMP XI.S6 will be implemented for the Structures Monitoring Program. Otherwise, provide adequate technical justification for the exception taken to the GALL Report AMP recommendation.
3. Update the LRA and FSAR supplement, as appropriate, to be consistent with the response to the above requests.

Waterford 3 Response

1. WF3 has identified the following high-strength structural bolting with actual measured yield strength greater than or equal to 150 ksi in sizes greater than 1 inch diameter that is within the scope of the Structures Monitoring Program. The reactor coolant pumps (RCP), safety injection tanks (SIT) and reactor coolant system (RCS) supports have bolting consisting of ASTM A-540 threaded bolts/studs. These bolts/studs with minimum yield strength of 150 ksi are monitored in the Structures Monitoring Program by visual inspection.

   WF3 has determined through review of site documentation (specifications, drawing, certified material requests, etc.) that there are no other high-strength structural bolts with actual measured yield strength greater than or equal to 150 ksi in sizes greater than 1 inch diameter within the scope of the Structures Monitoring Program.

2. The “parameters monitored or inspected,” and “detection of aging effects” program elements of NUREG-1801 AMP XI.S6 provide recommendations for managing cracking of high-strength bolts due to stress corrosion cracking (SCC). In the WF3 Structures Monitoring Program, these recommendations are not necessary because the environmental conditions for SCC are not present for the high-strength bolting identified in Part 1 of this response.

   NUREG-1801 AMP XI.S6 “detection of aging effects” program element states that visual inspection of high-strength bolting is supplemented with volumetric or surface examination to detect cracking. Justification for waiving volumetric and surface examination of WF3 high-strength bolting follows.

   The A-540 bolts/studs associated with each SIT are in an area outside the secondary shield walls that is dry and relatively cool. The A-540 bolts/studs associated with the RCP and RCS are part of the “stop supports” for these components. This bolting is located inside the steel containment vessel and the components are not exposed to an aggressive environment (i.e. high stress, wet environment with high oxygen levels or lubricant containing molybdenum disulfide) conducive to SCC. The Boric Acid Corrosion Program provides for inspections during each refueling outage to identify borated water leakage and ensure that corrosion caused by leaking borated water does not lead to unacceptable degradation of the leakage source or adjacent structures or components. Inspections are also conducted inside containment prior to startup from each refueling to ensure no adverse conditions exist that would result in a change to the normal operating environment. The thread lubricant used for this bolting material is N-5000, Anti-Seize lubricant which is a nickel/graphite-based thread lubricant not containing molybdenum disulfide. A review of operating records concluded that lubricants containing molybdenum disulfide have never been used for this bolting. Because these connections are in a noncorrosive and low-temperature environment, stress corrosion cracking in these bolts is not expected. The Structures Monitoring Program and Boric Acid Corrosion Program inspections of the SIT, RCP and RCS support bolting, performed at least once every five years and once every refueling outage respectively, provide reasonable assurance that environmental conditions will be maintained that are not conducive to SCC. Therefore, cracking due to SCC is not an aging effect requiring management for these bolts.

3. Consistent with the response to RAI B.1.16-1 and with the response above, LRA Table 3.5.1 items 3.5.1-68 and 3.5.1-69 discussion, related Table 2.4-1 and Table 3.5.2-1 are revised.

LRA revisions are as follows. Additions are shown with underline and deletions with strikethrough.

LRA Table 2.4-1:

Reactor Building
Components Subject to Aging Management Review

Component	Intended Function
Steel and Other Metals	
<u>High-strength bolting (RCP,RCS and SIT)</u>	<u>Support for Criterion (a)(1) equipment</u>

LRA Table 3.5.1: Structures and Component Supports

Item Number	Component	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
3.5.1-68	High-strength structural bolting	Cracking due to stress corrosion cracking	ISI (IWF)	No	WF3 does not have high-strength structural bolts with actual measured yield strength greater than or equal to 150 ksi in sizes greater than 1 inch diameter within the scope of the WF3 Inservice Inspection-IWF Program. ~~NUREG-1801 item referencing this item defines the bolting susceptible to SCC as: high strength (actual measured yield strength greater than or equal to 150 kilo pound per square inch [ksi] or greater than or equal to 1,034 MPa) for structural bolts greater than 1 inch (25 mm) in diameter. Per EPRI 1015078, a periodically wetted environment and the use of thread lubricant containing molybdenum disulfide must be present to initiate SCC in high yield-strength bolting. Since Molybdenum disulfide thread lubricants are not used at WF3, for structural bolting applications, SCC of high strength structural bolting is not an aging effect requiring management at WF3.~~

3.5.1-69	High-strength structural bolting	Cracking due to stress corrosion cracking	Structures Monitoring Program Note: ASTM A 325, F 1852, and ASTM A 490 bolts used in civil structures have not shown to be prone to SCC. SCC potential need not be evaluated for these bolts.	No	WF3 does not have high-strength bolts that are subject to sustained high tensile stress in a corrosive environment. As defined for bolting in this line item, ASTM A 325, F 1852, and ASTM A 490 bolts used in civil structures have not shown to be prone to SCC. However, WF3 has identified ASTM A-540 structural bolting with yield stress greater than or equal to 150 ksi. This bolting is not subject to high temperature and a corrosive environment. ~~WF3 procedures do not identify the use of high strength bolts ASTM A325 and A-490 for structural applications.~~ Therefore, the listed aging effect is not applicable for WF3 high strength bolting. Nevertheless, the Boric Acid Corrosion and Structures Monitoring Programs will be used to manage aging effects for this bolting.

LRA 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
High-strength bolting (RCP,RCS and SIT supports)	SSR	Carbon steel	Air – indoor uncontrolled	Cracking	Boric Acid Corrosion Structures Monitoring	III.B.5.TP-300	3.5.1-69	E