applicant concerning the specific issues to determine whether the applicant has properly applied the scoping criteria of 10 CFR 54.4(a) and the screening criteria of 10 CFR 54.21(a)(1):

> Based on its review of LRA Sections 2.1, 2.2, 2.3, 2.4, and 2.5, the staff identified a number of scoping and screening issues that require clarification and additional information. It is not clear to the staff how the applicant has addressed the following commodities in its scoping and screening evaluation: cable trays, conduit, instrument lines, TubeTrac (if applicable), thermal insulation on piping and/or structures that performs an intended function. The applicant is requested to (1) specifically describe the treatment of each of these commodities in its scoping and screening evaluation; (2) identify the specific table and row in LRA Section 2.3, 2.4, or 2.5 that includes each commodity; and (3) identify the location in LRA Section 3 that contains the AMR for each commodity.

The applicant's response to RAI 2.4-2, dated May 19, 2004, is given below:

> Cable trays:
> (1) Cable trays were treated as in scope and subject to aging management review.
> (2) Table 2.4-4, under the entry "Cable tray and conduit supports, embedded unistrut."
> (3) As shown in Table 3.5.2-4 under the same component entry.
>
> Conduit:
> (1) Conduit was treated as in scope and subject to aging management review.
> (2) Table 2.4-4, under the entry "Cable tray and conduit supports, embedded unistrut."
> (3) As shown in Table 3.5.2-4 under the same component entry.
>
> Instrument lines:
> (1) Instrument lines were treated as in scope and subject to aging management review. This component is referred to as tubing in the LRA.
> (2) As shown in the following tables.

2.3.1-3	2.3.2-1	2.3.2-2	2.3.2-4	2.3.2-5
				2.3.3-2
2.3.3-3	2.3.3-4	2.3.3-5	2.3.3-6	2.3.3-7
				2.3.3-8
2.3.3-9	2.3.3-10	2.3.3-11	2.3.4-1	2.3.4-2
				2.3.4-3
2.4-4				

(3) Instrument line/tubing aging management review is addressed in the following table:

3.1.2-3	3.2.2-1	3.2.2-2	3.2.2-4	3.2.2-5
				3.3.2-2
3.3.2-3	3.3.2-4	3.3.2-5	3.3.2-6	3.3.2-7
				3.3.2-8
3.3.2-9	3.3.2-10	3.3.2-11	3.4.2-1	3.4.2-2
				3.4.2-3
3.5.2-4				

TubeTrac:

(1) Tubing support systems, considered component supports, are in scope and subject to aging management review.
(2) As listed in Table 2.4-4, under the entry "component supports."
(3) As shown in Table 3.5.2 4 under the same component entry.

Thermal insulation on piping and/or structures that performs an intended function:

In some internal plant locations at ANO-2, insulation on piping has the intended function to limit heat loss in order to reduce area heat loads during accident conditions. This insulation is indoors and hence is protected from the weather. A review of ANO-2 operating experience verified that the plant has not experienced aging related degradation of piping insulation in indoor environments. Therefore, based on operating experience, there are no aging effects requiring management for indoor insulation at ANO-2. This is consistent with NUREG 1705, which states: "The staff concludes that, even if the chemical volume control system relied on the insulation to perform any accident mitigation functions, there are no plausible aging effects for the insulation that would warrant an aging management program."

Based on its review, the staff finds the applicant's response to RAI 2.4-2 acceptable for cable trays, conduit, instrument lines, and TubeTrac, because the information submitted is sufficient to address the staff's concerns. The applicant identified cable trays, conduit, instrument lines, and TubeTrac as within the scope of license renewal and subject to an AMR. The applicant identified the relevant applicable tables and row entries for the scoping and screening review and for the AMR for each of these commodities. The staff concludes that the applicant has properly applied the scoping criteria of 10 CFR 54.4(a) and the screening criteria of 10 CFR 54.21(a)(1) to ANO-2 cable trays, conduit, instrument lines, and TubeTrac. Therefore, the staff considers its concern described in RAI 2.4-2 resolved for cable trays, conduit, instrument lines, and TubeTrac.

Based on its review, the staff did not find the applicant's response to RAI 2.4-2 acceptable for thermal insulation, because the applicant's scoping and screening evaluation for thermal insulation appears to be flawed. In its RAI response, the applicant indicated that some thermal insulation has an intended function. However, the applicant apparently excluded this insulation from the scope of license renewal on the basis that there are no aging effects requiring management.

The staff noted that the scoping process for thermal insulation serves to identify all thermal insulation at ANO-2 that provides an intended function, in accordance with 10 CFR 54.4(a)(1–3). All thermal insulation that serves an intended function is within the scope of license renewal.

In a meeting on July 20, 2004, the staff requested the applicant to identify any thermal insulation at ANO-2 that serves an intended function, in accordance with 10 CFR 54.4(a)(1–3), describe plant-specific operating experience related to degradation of thermal insulation in general and thermal insulation that serves an intended function, and describe the scoping and screening evaluation for thermal insulation that serves an intended function, including the technical basis for either inclusion within or exclusion from the scope of license renewal. The staff indicated that the requested clarification should focus on insulation on hot containment piping penetrations.

The applicant's supplemental response to RAI 2.4-2 for thermal insulation, dated August 18, 2004, is given below:

> The insulation on hot containment piping penetrations is not required to ensure the functions of 10 CFR 54.4(a)(1) are accomplished or to demonstrate compliance with Commission regulations identified in 10 CFR 54.4(a)(3). The insulation does not meet 10 CFR 54.4(a)(2) as its failure will not prevent satisfactory accomplishment of any of the functions identified in 10 CFR 54.4(a)(1). Insulation on hot piping at containment penetrations does support normal ventilation systems in maintaining the environment for surrounding structural elements. However, maintaining the environment during normal operation is not an intended function identified in 10 CFR 54.4(a)(1). The fact that normal ventilation systems are not in the scope of license renewal supports this conclusion. In summary, thermal insulation on hot piping at containment penetration does not meet the scoping criteria of 10 CFR 54.4. This is consistent with the previously approved staff position documented in the safety evaluation report (SER) related to the license renewal of North Anna and Surry power stations, NUREG-1766, Section 2.1.3.1.
>
> Notwithstanding the above, Entergy performed an aging management review of the insulation on hot containment piping penetrations for ANO-2 even though it is not considered in the scope of license renewal. The aging management review did not identify any aging effects requiring management. ANO-2 hot piping penetration insulation is protected by its installation indoors in the annulus between the penetration piping and the penetration sleeve. The review of plant-specific operating experience for license renewal identified no age-related degradation of thermal insulation indoors, including insulation on hot piping at containment penetrations.
>
> Degradation of concrete due to exposure to elevated temperatures is a long-term process. Maintaining concrete temperatures below the degradation threshold values during long-term, normal operation is essential to ensure that there is no degradation of concrete properties. If thermal insulation on hot piping that penetrates containment is relied on (solely or in conjunction with ventilation systems) to meet the concrete temperature criteria, then the staff concludes that

it serves an intended function for license renewal, in accordance with 10 CFR 54.4(a)(2), and needs to be included in the scope of license renewal.

In a letter dated September 15, 2004, the applicant stated that thermal insulation around hot piping penetrations is included in the scope of license renewal for ANO-2. The applicant performed an aging management review of the insulation. Based on the consideration of the materia and environment, its protected location, and operating experience, there are no aging effects requiring management for the insulation around hot piping penetrations. The staff considers its concern described in RAI 2.4-2 resolved.

2.4.5.3 Conclusion

The staff reviewed the LRA and related structural/component information, including the accompanying scoping boundary drawings (if applicable), to determine whether the applicant failed to identify any SSCs that should be within the scope of license renewal. In addition, the staff performed an independent assessment to determine whether the applicant failed to identify any components that should be subject to an AMR. On the basis of its review, the staff concludes that the applicant has adequately identified the components of the bulk commodities that are within the scope of license renewal, as required by 10 CFR 54.4(a), and the components of the bulk commodities that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.5 Scoping and Screening Results—Electrical and Instrumentation and Controls Systems

This section addresses the scoping and screening results of electrical and I&C systems at ANO-2 for license renewal. According to 10 CFR 54.21(a)(1), an applicant must identify and list SCs subject to an AMR, which are passive, long-lived SCs that are within the scope of license renewal. To determine whether that the applicant has properly implemented its methodology, the staff focuses its review on the implementation results. Such focus allows the staff to confirm that the applicant did not omit any electrical system components that are subject to an AMR. If the review identifies no omission, the staff has a basis to find that the applicant has identified the electrical system components that are subject to an AMR.

2.5.1 Summary of Technical Information in the Application

In LRA Table 2.5.1, the applicant listed electrical and instrumentation and control system components that are within the scope of license renewal. The following structure and component/commodity groups were identified by the applicant as within the scope of license renewal:

- Electrical cables and connections not subject to 10 CFR 50.49 EQ requirements
- Inaccessible medium-voltage ($.16kV to 34.5kV) cables not subject to 10 CFR 50.49 EQ requirements
- Electrical connectors not subject to 10 CFR 50.49 EQ requirements that are exposed to borated water leakage
- Switchyard bus (switchyard bus for SBO) bus bars, connections
- High voltage insulators

2.5.2 Staff Evaluation

The staff performed its evaluation of the information provided in the LRA in the same manner for all electrical and I&C systems. Through its review, the staff sought to determine if the applicant identified as within the scope of license renewal those SSCs for a specific electrical or I&C system that appear to meet the scoping criteria, in accordance with 10 CFR 54.4. Similarly, the staff evaluated the applicant's screening results to determine whether all long-lived, passive components are subject to an AMR, in accordance with 10 CFR 54.21(a)(1).

To perform its evaluation, the staff reviewed the applicable LRA section and associated component drawings, focusing its review on components that the applicant did not identify as within the scope of renewal. The staff reviewed relevant licensing basis documents, including the UFSAR, for each electrical and I&C component to determine if the applicant omitted components with intended functions delineated under 10 CFR 54.4(a) from the scope of license renewal. The staff also reviewed the licensing basis documents to determine if all intended functions delineated under 10 CFR 54.4(a) are specified in the LRA. If it identified omissions, the staff requested additional information to resolve the discrepancy.

Once the staff completed its review of the scoping results, it evaluated the applicant's screening results. For those SCs with intended functions, the staff sought to determine if the functions are performed with moving parts or a change in configuration or properties (i.e., passive), or if they are subject to replacement based on a qualified life or specified time period (i.e., long-lived), as described in 10 CFR 54.21(a)(1). For those that do not meet either of these criteria, the staff sought to confirm that these electrical and I&C components are subject to an AMR as required by 10 CFR 54.21(a)(1). If it identified discrepancies, the staff requested additional information to resolve them.

The staff reviewed LRA Section 2.5 to determine if the applicant identified the electrical and I&C systems and components within the scope of license renewal and subject to an AMR in accordance with 10 CFR 54.4 and 10 CFR 54.21(a)(1).

In performing the review, the staff selected system functions described in the FSAR and set forth in 10 CFR 54.4 to determine whether the applicant did not omit components having intended functions from the scope of the Rule. The staff also reviewed drawings and focused on components that the applicant did not identify as subject to an AMR to determine if it omitted any components.

As part of its review, the staff requested additional information in a letter dated May 25, 2004. In RAI 2.5-1, the staff requested that the applicant explain why uninsulated ground conductors are not subject to AMR. The applicant responded to the RAI in a letter to the staff dated June 21, 2004. In its response, the applicant stated that uninsulated ground conductors (e.g., grounding rods, buried ground cables, and cathodic protection) are not subject to AMR because this commodity group does not perform a license renewal intended function. Furthermore, noninsulated ground conductors do not meet any of the scoping criteria specified in 10 CFR 54.4. These components are not safety related per 10 CFR 54.4(a)(1) and are not credited for mitigation of regulated events listed in 10 CFR 54.4(a)(3).

The applicant stated that industry and plant-specific operating experience for uninsulated ground conductors does not indicate credible failure modes that would adversely impact an intended function; therefore, equipment failures caused by uninsulated ground conductors are considered hypothetical. As discussed in SRP-LR Section 2.1.3.1.2 and SOC Section III.c(iii) (Volume 60 of the *Federal Register*, page 22467 (60 FR 22467)), hypothetical failures are not required to be considered for license renewal if they are not included in the CLB. The applicant also stated that the failure of an uninsulated ground conductor will not prevent satisfactory accomplishment of any of the functions identified in 10 CFR 54.4(a)(1).

Based on this response, the staff concludes that uninsulated ground conductors do not perform or support any safety-related functions or any of the regulated events identified in 10 CFR 54.4(a). Therefore, the passive electrical commodity of uninsulated ground conductors is not within the scope of license renewal.

Table 2.5-1 of the LRA lists the commodity group "switchyard bus (switchyard bus for SBO), bus bars, connections)." The staff requested the applicant to clarify whether this commodity group includes the phase bus (e.g., isolated-phase bus and segregated and nonsegregated phase bus). In its response to the staff RAI, the applicant stated that the commodity group "switchyard bus (switchyard bus for SBO), bus bars, and connections" includes the phase bus (e.g., isolated-phase bus and segregated and nonsegregated phase bus). This commodity

group is subject to AMR since ANO-2 uses a nonsegregated phase bus to connect the offsite ac power source (via the startup transformer) to the 4.16-kilovolt (kV) switchgear. Table 3.6.2-1 of the LRA includes the phase bus; however, the applicant did not identify any aging effects requiring management for the phase bus. Plant-specific operating experience confirms that the phase bus has satisfactorily performed its intended function since initial plant operation without aging effects requiring management. Based on this information, the staff concludes that the applicant did not omit the phase bus at ANO-2.

Table 2.5-1 of the LRA lists the commodity group "electrical cables and connections not subject to 10 CFR 50.49 EQ requirements." The staff requested the applicant to clarify whether this commodity group includes the electrical portions of electrical and I&C penetration assemblies (e.g., electrical penetration assembly cables and connections). In its response to the staff RAI, the applicant stated that the commodity group "electrical cables and connections not subject to 10 CFR 50.49 EQ requirements" includes the electrical portions of electrical and I&C penetration assemblies (e.g., electrical penetration assembly cables and connections), and that the applicant performed an AMR. The item on electrical cables and connections not subject to 10 CFR 50.49 EQ requirements in Table 3.6.2-1 identifies the aging effects and AMP for non-EQ electrical and I&C penetration cables and connections. Based on this information, the staff concludes that the applicant did not omit the electrical penetration assembly cables and connections at ANO-2.

Interim Staff Guidance (ISG)-2, "NRC Staff Position on License Renewal Rule (10 CFR 54.4) As It Relates to the Station Blackout Rule (10 CFR 50.63)," states the following:

> The offsite power systems consist of a transmission system (grid) component that provides a source of power and a plant system component that connects the power source to a plant's onsite electrical distribution systems which power safety equipment. For the purpose of the license renewal rule, the staff has determined that the plant system portion of the offsite power system that is used to connect the plant to the offsite power source should be included within the scope of the rule.

The staff requested the applicant to provide a detailed description of the ANO-2 recovery path and discuss how the recovery path is included within the scope of license renewal to comply with ISG-2.

In response to the staff's request, the applicant, in a letter dated June 21, 2004, responded that per ISG-2, the ANO-2 LRA scope for SBO includes the switchyard circuit breakers feeding Startup Transformer #3, Startup Transformer #3, the circuit breaker-to-transformer and transformer-to-onsite electrical interconnections, and the associated control circuits and structures. Additionally, the applicant stated that it also included the voltage regulator since it is part of the interconnection between the switchyard circuit breaker and the startup transformer.

The applicant further explained that the boundary between the transmission system (grid) offsite power source and the plant system components is the 22-kV/4.16-kV startup transformer (Startup Transformer #3). The 22-kV switchyard circuit breaker (B0126) that feeds Startup Transformer #3 at ANO-2 is the offsite power connection point to the transmission system that is the boundary point described in ISG-2 (first switchyard breaker). Medium-voltage insulated cable, installed in an underground duct bank, runs between the switchyard circuit breaker

B0126 and the Startup Transformer #3 voltage regulator. A switchyard bus connects breaker B0126 and the voltage regulator to the medium-voltage insulated cables. Medium-voltage insulated cable, installed in an underground duct bank, runs between the voltage regulator and Startup Transformer #3. A switchyard bus connects the voltage regulator and Startup Transformer #3 to the medium-voltage insulated cables. High-voltage insulators, which are used with the switchyard bus, are included in the scope of license renewal for the SBO recovery path. Startup Transformer #3 is connected to the 4.16-kV safety buses with a nonsegregated phase bus.

Instrument and control cables for the switchyard circuit breaker B0126, the voltage regulator, and Startup Transformer #3 are also included in the scope of license renewal for this recovery path. The item for the program covering electrical cables and connections not subject to 10 CFR 50.49 EQ requirements, listed in LRA Table 3.6.2-1, includes these cables.

As described above, the applicant only included a single path for SBO recovery in its LRA. That SBO recovery path includes the connections from Startup Transformer #3 to switchyard circuit breaker B0126. During a July 20, 2004, public meeting, the staff requested that the applicant include an alternate offsite power source in the scope of license renewal.

In a letter dated August 18, 2004, the applicant provided an alternate offsite power source in the scope of license renewal. In the letter, the applicant stated that the alternate offsite power source for Startup Transformer #2 is a component from ANO-1 credited for meeting General Design Criterion (GDC) 17, "Electric Power Systems." As stated in the ANO-2 FSAR Section 8.1.4, ANO-2 can supply electric power to the onsite electric distribution system from two physically independent transmission network circuits, Startup Transformer #3, which is an ANO-2 offsite power component, and Startup Transformer #2, which is an ANO-1 offsite power component. The switchyard autotransformer bank supplies Startup Transformer #3 through underground cables. The 161-kV switchyard ring bus supplies Startup Transformer #2.

Two 161-kV circuit breakers separate the 161-kV switchyard from the autotransformer. The failure of any one of the 161-kV circuit breakers will trip the adjacent circuit breakers and interrupt only one of the plant offsite power sources. The 500-kV lines and the autotransformer will remain available during that event. Conversely, the failure of a 500-kV circuit breaker which feeds the autotransformer will trip the two 161-kV circuit breakers connected to the autotransformer but will not interrupt the 161-kV circuit to the plant.

Section 8.2.1.2.G of the FSAR describes the overhead 161-kV transmission conductors from 161-kV switchyard circuit breakers B1291 and B1250 to Startup Transformer #2. The high-voltage insulators associated with the transmission conductors are similar to the high-voltage insulators for the switchyard bus, which the applicant addressed in Section 3.6 of its LRA.

The inclusion of 161-kV switchyard circuit breakers B1291 and B1250 (first switchyard breakers), the associated overhead transmission conductors, and Startup Transformer #2 in the scope of license renewal required modification of the applicant's response to RAI 2.5-1(c)), provided in its June 21, 2004, letter.

In the revised response, the applicant stated that, based on the inclusion of Startup Transformer #2, transmission conductors, strain and suspension insulators, and insulated cables are subject to an AMR. The LRA includes insulated cables. The transmission

conductors component type includes the transmission conductors and the hardware used to secure the conductors to insulators. Section 3.6 of this SER provides details of the applicant's AMR of transmission conductors. Based on this information, the staff concludes that the applicant did not omit transmission conductors at ANO-2.

2.5.3 Conclusion

On the basis of this review, the staff concludes that the applicant has adequately identified the electrical and I&C systems and components that are within the scope of license renewal in accordance with the requirements of 10 CFR 54.4(a), and the electrical and I&C systems components that are subject to an AMR in accordance with the requirements of 10 CFR 54.21(a)(1).

2.6 Conclusion

The staff has reviewed the information in Section , "Scoping and Screening Methodology for Identifying Structures and Components Subject to Aging Management Review and Implementation Results " of the LRA. On the basis of its review, the staff concludes that the applicant has identified those structures and components that are within the scope of license renewal, as required by 10 CFR 54.4(a), and subject to an AMR, as required by 10 CFR 54.21(a)(1).

With regard to these matters, the NRC staff has concluded that there is reasonable assurance that the activities authorized by the renewed license will continue to be conducted in accordance with the current licensing basis, and that any changes made to the ANO-2 current licensing basis in order to comply with 10 CFR 54.29(a) are in accord with the ACT and the Commission's regulations.

3. AGING MANAGEMENT REVIEW RESULTS

This Section of the SER contains the staff's evaluation of the applicant's aging management programs (AMPs) and aging management reviews (AMRs). In Appendix B of the LRA, the applicant described the 33 AMPs that it relies on to manage or monitor the aging of long-lived, passive components and structures. In Section 3 of the LRA, the applicant provided the results of the AMRs for those structures and components that were identified in Section 2 of the LRA as being within the scope of license renewal and subject to an AMR.

3.0 Applicant's Use of the Generic Aging Lessons Learned Report

In preparing its license renewal application (LRA), Entergy Operations, Inc. (Entergy, the applicant) credited NUREG-1801, "Generic Aging Lessons Learned (GALL) Report," dated July 2001. The GALL Report contains the staff's generic evaluation of the existing plant programs and documents the technical basis for determining where existing programs are adequate without modification and where existing programs should be augmented for the extended period of operation. The evaluation results documented in the GALL Report indicate that many of the existing programs are adequate to manage the aging effects for particular structures or components for license renewal without change. The GALL Report also contains recommendations on specific areas for which existing programs should be augmented for license renewal. An applicant may reference the GALL Report in its LRA to demonstrate that the programs at its facility correspond to those reviewed and approved in the report.

The purpose of the GALL Report is to provide the staff with a summary of staff-approved AMPs to manage or monitor the aging of structures and components that are subject to an AMR. If an applicant commits to implementing these staff-approved AMPs, the time, effort, and resources used to review an applicant's LRA will be greatly reduced, thereby improving the efficiency and effectiveness of the license renewal review process. The GALL Report also serves as a reference for applicants and staff reviewers to quickly identify those AMPs and activities that the staff has determined will adequately manage or monitor aging during the period of extended operation.

The GALL Report identifies (1) systems, structures, and components (SSCs), (2) structure and component (SC) materials, (3) the environments to which the SCs are exposed, (4) the aging effects associated with the materials and environments, (5) the AMPs that are credited with managing or monitoring the aging effects, and (6) recommendations for further applicant evaluations of aging management for certain component types.

To determine whether using the GALL Report would improve the efficiency of the license renewal review, the staff conducted a demonstration project to exercise the GALL process and to determine the format and content of a safety evaluation based on this process. The results of the demonstration project confirmed that the GALL process will improve the efficiency and effectiveness of the LRA review while maintaining the staff's focus on public health and safety. NUREG-1800, "Standard Review Plan for the Review of License Renewal Applications," dated April 2001 (SRP-LR), was prepared based on both the GALL Report model and lessons learned from the demonstration project.

The staff performed its work in accordance with the requirements of Title 10 of the *Code of Federal Regulations*, Part 54 (10 CFR 54), "Requirements for Renewal of Operating Licenses for Nuclear Power Plants;" the guidance provided in NUREG-1800, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants" (SRP-LR), dated July 2001; the guidance provided in NUREG-1801, "Generic Aging Lessons Learned (GALL) Report," dated July 2001; and the "Audit and Review Plan for Plant Aging Management Reviews and Programs - Arkansas Nuclear One, Unit 2" dated July 29, 2004 (ML041550872).

The staff performed audits and technical reviews of the license renewal applicant's AMPs and AMRs. These audits and reviews are to determine whether the effects of aging on structures and components can be adequately managed so that their intended functions can be maintained consistently with the plant's current licensing basis (CLB) for the period of extended operation as required by 10 CFR 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

During its review of the Arkansas Nuclear One, Unit 2 (ANO-2) LRA, the staff performed on-site audits and reviews during the weeks of December 1, 2003, and February 9, 2004, to determine that AMP and AMR results that the applicant claimed were consistent with the GALL Report were actually consistent as claimed. Details of the staff's evaluation of the audits and reviews are documented in the "Audit and Review Report for Plant Aging Management Reviews - Arkansas Nuclear One, Unit 2 ," (ANO-2 Audit and Review Report) dated August 19, 2004 (ML0422400840).

The on-site audits and reviews are designed to maximize the efficiencies of the staff's review of the LRA. The need for formal correspondence between staff and the applicant was reduced, and therefore, improved the efficiency of the review. Also the applicant could respond to questions, and the staff could readily evaluate the responses made by the applicant.

Overall, as set out in the SER, the staff determined that the applicant's aging management activities and programs can adequately manage the effects of aging on structures and components, so that their intended functions can be maintained consistent with the current licensing basis (CLB) for the period of extended operation.

3.0.1 Format of the Licence Renewal Application (LRA)

Entergy Operations, Inc. (Entergy, the applicant) submitted an application that followed the standard LRA format, as agreed to between the NRC staff and the Nuclear Energy Institute (NEI) (see letter dated April 7, 2003). This revised LRA format incorporates lessons learned from the staff's reviews of the previous LRAs. These previous applications used a format developed from information gained during an NRC staff and NEI demonstration project conducted to evaluate the use of the GALL Report in the staff's review process.

The organization of Section 3 of the LRA parallels Chapter 3 of the SRP-LR. The AMR results information in Section 3 of the LRA is presented in the following two table types.

- Table 1: Table 3.x.1 - where "3" indicates the LRA section number, "x" indicates the subsection number from the GALL Report, and "1" indicates that this is the first table type in Section 3 of the LRA.

- Table 2: Table 3.x.2-y - where "3" indicates the LRA section number, "x" indicates the subsection number of the GALL Report, "2" indicates that this is the second table type in Section 3 of the LRA, and "y" indicates the system table number.

The content of the previous applications and the ANO-2 application is essentially the same. The intent of the revised format used for the ANO-2 application was to modify the tables in Chapter 3 to provide additional information to assist the staff in its review. In Table 1 the applicant summarized the portions of the application it considered to be consistent with the GALL Report. In Table 2, the applicant identified the linkage between the scoping and screening results in Chapter 2 and the AMRs in Chapter 3.

3.0.1.1 Overview of Table 1

Table 3.x.1 (Table 1) provides a summary comparison of how the facility aligns with the corresponding tables of the GALL Report, Volume 1. The table is essentially the same as Tables 1 through 6 provided in the GALL Report, Volume 1, except that the "Type" column has been replaced by an "Item Number" column and the "Item Number in GALL" column has been replaced by a "Discussion" column. The "Item Number" column provides the reviewer with a means to cross-reference from Table 2 to Table 1. The "Discussion" column is used by the applicant to provide clarifying/amplifying information. The following are examples of information that might be contained within this column:

- Further Evaluation Recommended - information or reference to where that information is located
- The name of a plant-specific program being used
- Exceptions to the GALL Report assumptions
- A discussion of how the line is consistent with the corresponding line item in the GALL Report when that may not be intuitively obvious
- A discussion of how the item is different than the corresponding line item in the GALL Report (e.g., when there is exception taken to an aging management program that is listed in the GALL Report)

The format of Table 1 allows the staff to align a specific Table 1 row with the corresponding NUREG-1801, Volume 1, table row so that consistency can be checked easily.

3.0.1.2 Overview of Table 2

Table 2 provides the detailed results of the AMRs for those components identified in LRA Section 2 as being subject to an AMR. The LRA contains a Table 2 for each of the components or systems within a system grouping (e.g., reactor coolant systems, engineered safety features, auxiliary systems, etc.). For example, the engineered safety features group contains tables specific to the containment spray system, containment isolation system, and emergency core cooling system, Table 2 consists of the following nine columns:

Component Type - The first column identifies the component types from Section 2 of the LRA that are subject to aging management review. They are listed in alphabetical order.

Intended Function - The second column contains the license renewal intended functions (including abbreviations where applicable) for the listed component types. Definitions and abbreviations of intended functions are contained within the Intended Functions table of LRA Section 2.

Material - The third column lists the particular materials of construction for the component type.

Environment - The fourth column lists the environment to which the component types are exposed. Internal and external service environments are indicated and a list of these environments is provided in the Internal Service Environments and External Service Environments tables of LRA Section 3.

Aging Effect Requiring Management - The fifth column lists aging effects requiring management. As part of the aging management review process, the applicant determined any aging effects requiring management for each material and environment combination.

Aging Management Programs - The sixth column lists the aging management programs the applicant used to manage the identified aging effects.

GALL Vol. 2 Item - The seventh column lists the GALL Report item(s) that the applicant identified as being similar to the AMR results in its LRA. The applicant compared each combination of component type, material, environment, aging effect requiring management, and aging management program in Table 2 of the SER to the items in the GALL Report. If there were no corresponding item in the GALL Report, the applicant left the column blank. In this way, the applicant identified the AMR results in the LRA tables that corresponded to items in the GALL Report tables.

Table 1 Item - The eighth column lists the corresponding summary item number from Table 1. If the applicant identifies AMR results in Table 2 that are consistent with the GALL Report, then the associated Table 3.x.1 line summary item number should be listed in Table 2. If there is no corresponding item in the GALL Report, then column eight is left blank. That way, the information from the two tables can be correlated.

Notes - The ninth column lists the corresponding notes that the applicant used to identify how the information in Table 2 aligns with the information in the GALL Report. The notes identified by letters were developed by a Nuclear Energy Institute working group and will be used in future license renewal applications. Any plant-specific notes are identified by a number and provide additional information concerning the consistency of the line item with the GALL Report.

3.0.2 Staff's Review Process

The staff evaluated each row in Table 1 by moving from left to right across the table. Since the applicant reproduced the component, aging effect/mechanism, aging management programs and further evaluation recommended information from the SRP-LR, these table columns required no further staff review. The staff reviewed information provided by the applicant in the

Discussion column or other sections of the LRA to determine whether the applicant's AMR results and AMPs were consistent with the AMRs and AMP items in the GALL Report.

The staff conducted the following three types of evaluations of the AMRs and associated AMPs.

- For items the applicant stated were consistent with the GALL Report or consistent with a previously approved staff position, the staff conducted an audit.
- For items the applicant stated were consistent with the GALL Report with exceptions, the staff conducted an audit and review of the item and of the applicant's technical justification for the exceptions.
- For other items, the staff conducted a technical review. Additionally, the staff conducted a technical review for some items that were consistent with the GALL Report but associated with emerging technical issues.

3.0.2.1 Review of AMPs

For those AMPs for which the applicant claimed consistency with the GALL AMPs, the staff conducted an audit to confirm that the applicant's AMPs were consistent with the AMPs in the GALL Report.

For each AMP that had one or more deviations, the staff evaluated each deviation to determine (1) whether the deviation was acceptable, and (2) whether the AMP, as modified, would adequately manage the aging effect(s) for which it was credited.

For each AMP that was not evaluated in the GALL Report, the staff performed a full review to determine the adequacy of the AMP. The staff evaluated the AMP against the following 10 program elements defined in SRP-LR Appendix A.

1. Scope of program - Scope of the program should include the specific structures and components subject to an AMR for license renewal.
2. Preventive actions - Preventive actions should prevent or mitigate aging degradation.
3. Parameters monitored or inspected - Parameters monitored or inspected should be linked to the degradation of the particular structure or component intended functions(s).
4. Detection of aging effects - Detection of aging effects should occur before there is a loss of structure or component intended functions(s). This includes aspects such as method or technique (i.e., visual, volumetric, surface inspection), frequency, sample size, data collection and timing of new/one-time inspections to ensure timely detection of aging effects.
5. Monitoring and trending - Monitoring and trending should provide predictability of the extent of degradation, and timely corrective or mitigative actions.

6. Acceptance criteria - Acceptance criteria, against which the need for corrective action will be evaluated, should ensure that the structure or component intended function(s) are maintained under all CLB design conditions during the period of extended operation.

7. Corrective actions - Corrective actions, including root cause determination and prevention of recurrence, should be timely.

8. Confirmation process - Confirmation process should ensure that preventive actions are adequate and that appropriate corrective actions have been completed and are effective.

9. Administrative controls - Administrative controls should provide a formal review and approval process.

10. Operating experience - Operating experience of the aging management program, including past corrective actions resulting in program enhancements or additional programs, should provide objective evidence to support the conclusion that the effects of aging will be managed adequately so that the structure and component intended function(s) will be maintained during the period of extended operation.

The staff reviewed the applicant's corrective action program and documented its findings in Section 3.0.3 of this SER. The staff's evaluation of the corrective action program included assessment of the Corrective Actions, Confirmation Process, and Administrative Controls program elements. Consequently, the staff's documentation of its review of AMPs not consistent with the GALL Report AMPs only addresses 7 of the 10 program elements.

The staff reviewed the information concerning the operating experience program element for the AMPs that are consistent with GALL Report AMPs. Details of the staff's evaluation of the audit and review are documented in the ANO-2 Audit and Review Report.

The staff reviewed the Updated Final Safety Analysis Report (UFSAR) supplement for each AMP to determine if it provided an adequate description of the program or activity, as required by 10 CFR 54.21(d).

3.0.2.2 Review of AMR Results

Table 2 of the LRA contains information concerning whether or not the AMRs align with the AMRs identified in the GALL Report. For a given AMR in Table 2, the staff reviewed the intended function, material, environment, aging effect requiring management and aging management program combination for a particular component type within a system. The AMRs that correlate between a combination in Table 2 and a combination in the GALL Report were identified by a referenced item number in column seven, "GALL, Volume 2 Item." The staff conducted an audit to determine the correlation. A blank column seven indicates that the applicant was unable to locate an appropriate corresponding combination in the GALL Report. The staff conducted a technical review of these combinations that were not consistent with the GALL Report. The next column, "Table 1 Item," provided a reference number that indicated the corresponding row in Table 1.

3.0.2.3 NRC-Approved Positions

To help facilitate the staff review of the LRA, an applicant may reference NRC-approved positions to demonstrate that its non-GALL programs correspond to programs that the staff had approved for other plants during its review of previous applications for license renewal. When an applicant elects to proceed in this way , the staff determines whether the previously approved position is applicable to the applicant's facility, determines whether the plant program is bounded by the conditions for which the position was evaluated and approved, and determines whether that the plant program contains the program elements (or attributes) of the referenced NRC-approved position. In general, if the staff determines that these conditions are satisfied, it will use the information in the previously approved position to frame and focus its review of the applicant's program.

It is important to note that the reference information on previously approved positions provided by the applicant is not a part of the LRA; it is supplementary information voluntarily provided by the applicant as a reviewer's aid. The existence of a previously approved position, in and of itself, is not a sufficient basis to accept the applicant's program. Rather, the previously approved position facilitates the review of the substance of the matters described in the applicant's program. As such, in the NRC staff's documentation of its reviews of programs that are based on previously approved positions, the reference information is typically implicit in the evaluation rather than explicit. If the staff determines that a previously approved position identified by the applicant is not applicable to the particular plant program for which it is credited, it refers the program to the NRR, Division of Engineering (DE) for review in the traditional manner, i.e., as described in the SRP-LR, without consideration of the reference information provided by the applicant. The applicant chose to provide reference information on previously approved positions to support its selection of certain programs. Therefore, some of the staff reviews documented in this SER considered the reference information in the manner described above.

3.0.2.4 UFSAR Supplement

Consistent with the SRP-LR, for the AMRs and associated AMPs that it reviewed, the staff also reviewed the UFSAR supplement that summarizes the applicant's programs and activities for managing the effects of aging for the period of extended operation.

3.0.2.5 Documentation and Documents Reviewed

In performing its work, the staff relied heavily on the LRA, the SRP-LR, and the GALL Report. The staff also examined the applicant's precedent review documents and AMP basis documents (a catalog of the documentation used by the applicant to develop or justify its AMPs), and other applicant documents, including selected implementing procedures, to determine that the applicant's activities and programs will adequately manage the effects of aging on SCs.

Any discrepancies or issues discovered during the audit and review that required a formal response on the docket are documented in the staff's ANO-2 Audit and Review Report. If an issue was resolved prior to issuing the Report, a request for additional information (RAI) was prepared by the staff describing the issue and the information needed to disposition the issue. The RAI, if needed, is included and dispositioned in this ANO-2 SER related to the LRA. The

list of RAIs associated with the audit and review is provided in Attachment 3 to the staff's ANO-2 Audit and Review Report.

A list of documents reviewed by the staff is listed as Attachment 4 to the staff's ANO-2 Audit and Review Report. During its site visits, the staff also conducted detailed discussions and interviews with the applicant's license renewal project personnel and others with technical expertise relevant to aging management.

3.0.3 Aging Management Programs

Table 3.0.3-1 presents the AMPs credited by the applicant and described in Appendix B of the LRA. The table also indicates the GALL program that the applicant claimed its AMP was consistent with (if applicable) and the systems, structures, or components that credit the program for managing or monitoring aging. The section of the safety evaluation report in which the staff's evaluation of the program is documented also is provided.

Table 3.0.3-1
ANO-2's Aging Management Programs

ANO-2's AMP (LRA Section)	GALL Comparison	GALL AMP(s)	LRA Systems or Structures that Credit the AMP	Staff's SER Section
Existing AMPs				
Bolting and Torquing Activities Program (B.1.2)	Plant-specific	N/A	Reactor Vessel, Internals, and Reactor Coolant System; Engineered Safety Features Systems; Auxiliary Systems; Steam and Power Conversion Systems	3.0.3.3.2
Boric Acid Corrosion Prevention Program (B.1.3)	Consistent with enhancements	XI.M10	Reactor Vessel, Internals, and Reactor Coolant System; Engineered Safety Features Systems; Auxiliary Systems; Structures and Component Supports; Electrical and Instrumentation and Controls	3.0.3.2.1
Containment Leak Rate Program (B.1.6)	Consistent	XI.S4	Engineered Safety Features Systems; Structures and Component Supports	3.0.3.1
Diesel Fuel Monitoring Program (B.1.7)	Consistent with exceptions	XI.M30	Auxiliary Systems	3.0.3.2.3
Environmental Qualification (EQ) of Electric Components Program (B.1.8)	Consistent	X.E1	Electrical and Instrumentation and Controls	3.0.3.1 3.6.2.1.4
Fatigue Monitoring Program (B.1.9)	Consistent with exceptions	X.M1	Reactor Vessel, Internals, and Reactor Coolant System	3.0.3.2.4

ANO-2's AMP (LRA Section)	GALL Comparison	GALL AMP(s)	LRA Systems or Structures that Credit the AMP	Staff's SER Section
Fire Protection Program (B.1.10.1)	Consistent with exceptions	XI.M26	Auxiliary Systems; Structures and Component Supports	3.0.3.2.5.1
Fire Water System Program (B.1.10.2)	Consistent with one exception; one enhancement	XI.M27	Auxiliary Systems; Structures and Component Supports	3.0.3.2.5.2
Flow-Accelerated Corrosion Program (B.1.11)	Consistent	XI.M17	Reactor Vessel, Internals, and Reactor Coolant System; Engineered Safety Features Systems; Auxiliary Systems; Steam and Power Conversion Systems	3.0.3.1
Inservice Inspection – Containment Inservice Inspection (CII) Program (B.1.13)	Plant-specific	N/A	Structures and Component Supports	3.0.3.3.4
Inservice Inspection – Inservice Inspection (ISI) Program (B.1.14)	Plant-specific	N/A	Reactor Vessel, Internals, and Reactor Coolant System; Structures and Component Supports	3.0.3.3.5
Oil Analysis Program (B.1.17)	Plant-specific	N/A	Auxiliary Systems; Steam and Power Conversion Systems	3.0.3.3.6
Periodic Surveillance and Preventive Maintenance Program (B.1.18)	Plant-specific	N/A	Engineered Safety Features Systems; Auxiliary Systems; Steam and Power Conversion Systems; Structures and Component Supports	3.0.3.3.7
Pressurizer Examinations Program (B.1.19)	Plant-specific	N/A	Reactor Vessel, Internals, and Reactor Coolant System	3.0.3.3.8
Reactor Vessel Head Penetration Program (B.1.20)	Consistent	XI.M11	Reactor Vessel, Internals, and Reactor Coolant System	3.0.3.1
Reactor Vessel Integrity Program (B.1.21)	Consistent with enhancement	XI.M31	Reactor Vessel, Internals, and Reactor Coolant System	3.0.3.2.6
Service Water Integrity Program (B.1.24)	Consistent with exceptions/ enhancement	XI.M20	Engineered Safety Features Systems; Auxiliary Systems; Structures and Component Supports	3.0.3.2.7
Steam Generator Integrity Program (B.1.25)	Consistent	XI.M19	Reactor Vessel, Internals, and Reactor Coolant System	3.0.3.1

ANO-2's AMP (LRA Section)	GALL Comparison	GALL AMP(s)	LRA Systems or Structures that Credit the AMP	Staff's SER Section
Structures Monitoring – Masonry Wall Program (B.1.26)	Consistent	XI.S5	Structures and Component Supports	3.0.3.1
Structures Monitoring – Structures Monitoring Program (B.1.27)	Consistent	XI.S6	Structures and Component Supports	3.0.3.1
System Walkdown Program (B.1.28)	Plant-specific	N/A	Reactor Vessel, Internals, and Reactor Coolant System; Engineered Safety Features Systems; Auxiliary Systems; Steam and Power Conversion Systems	3.0.3.3.9
Water Chemistry Control – Auxiliary Systems Water Chemistry Control Program (B.1.30.1)	Plant-specific	N/A	Auxiliary Systems; Steam and Power Conversion Systems	3.0.3.3.11
Water Chemistry Control – Closed Cooling Water Chemistry Control Program (B.1.30.2)	Consistent with exceptions	XI.M21	Reactor Vessel, Internals, and Reactor Coolant System; Auxiliary Systems; Steam and Power Conversion Systems; Structures and Component Supports	3.0.3.2.8
Water Chemistry Control – Primary and Secondary Water Chemistry Control Program (B.1.30.3)	Consistent	XI.M2	Reactor Vessel, Internals, and Reactor Coolant System; Engineered Safety Features Systems; Auxiliary Systems; Steam and Power Conversion Systems; Structures and Component Supports	3.0.3.1
New AMPs				
Alloy 600 Aging Management Program (B.1.1)	Plant-specific	N/A	Reactor Vessel, Internals, and Reactor Coolant System	3.0.3.3.1
Buried Piping Inspection Program (B.1.4)	Consistent with exceptions	XI.M34	Auxiliary Systems	3.0.3.2.2
Cast Austenitic Stainless Steel (CASS) Evaluation Program (B.1.5)	Consistent	XI.M12	Reactor Vessel, Internals, and Reactor Coolant System	3.0.3.1
Heat Exchanger Monitoring Program (B.1.12)	Plant-specific	N/A	Engineered Safety Features Systems; Auxiliary Systems	3.0.3.3.3

ANO-2's AMP (LRA Section)	GALL Comparison	GALL AMP(s)	LRA Systems or Structures that Credit the AMP	Staff's SER Section
Non-EQ Inaccessible Medium-Voltage Cable Program (B.1.15)	Consistent	XI.E3	Electrical and Instrumentation and Controls	3.0.3.1
Non-EQ Insulated Cables and Connections Program (B.1.16)	Consistent	XI.E1	Electrical and Instrumentation and Controls	3.0.3.1
Reactor Vessel Internals Cast Austenitic Stainless Steel Components Program (B.1.22)	Consistent	XI.M13	Reactor Vessel, Internals, and Reactor Coolant System	3.0.3.1
Reactor Vessel Internals Stainless Steel Plates, Forgings, Welds, and Bolting Program (B.1.23)	Consistent	XI.M16	Reactor Vessel, Internals, and Reactor Coolant System	3.0.3.1
Wall Thinning Monitoring Program (B.1.29)	Plant-specific	N/A	Auxiliary Systems	3.0.3.3.10

3.0.3.1 AMPs that are Consistent with the GALL Report

In Appendix B of the LRA, the applicant indicated that the following AMPs were consistent with the GALL Report:

- Cast Austenitic Stainless Steel (CASS) Evaluation Program (B.1.5)
- Containment Leak Rate Program (B.1.6)
- Environmental Qualification (EQ) of Electric Components Program (B.1.8)
- Flow-Accelerated Corrosion Program (B.1.11)
- Non-EQ Inaccessible Medium-Voltage Cable Program (B.1.15)
- Non-EQ Insulated Cables and Connections Program (B.1.16)
- Reactor Vessel Head Penetration Program (B.1.20)
- Reactor Vessel Internals Cast Austenitic Stainless Steel Components Program (B.1.22)
- Reactor Vessel Internals Stainless Steel Plates, Forgings, Welds, and Bolting Program (B.1.23)
- Steam Generator Integrity Program (B.1.25)
- Structures Monitoring – Masonry Wall Program (B.1.26)
- Structures Monitoring – Structures Monitoring Program (B.1.27)
- Water Chemistry Control – Primary and Secondary Water Chemistry Control Program (B.1.30.3)

During the audit that was conducted by the staff on December 1-5, 2003, the staff reviewed selected documents and procedures associated with the AMPs that are listed above. During the technical review of the Reactor Vessel Internals Cast Austenitic Stainless Steel

Components Program (B.1.22) and Reactor Vessel Internals Stainless Steel Plates, Forgings, Welds, and Bolting Program (B.1.23), aspects pertaining to void swelling were under development and not available for staff review. The applicant has committed to further understanding of this aging effect through industry programs to provide additional bases for supplemental examinations or component-specific evaluations.

3.0.3.1.1 Reactor Vessel Internal Programs

Since the details of the Reactor Vessel Internals Cast Austenitic Stainless Steel Components Program have yet to be developed, including the details on location of components for examination, inspection methods and qualifications, and frequency of examinations, the scope of the AMP has yet to be finalized. The staff therefore issued RAI B.1.22-1 and requested that the applicant formally make a commitment to submit a description of the program, including its inspection plan, to the NRC staff for review and approval no later than three years prior to the period of extended operation.

The applicant responded to RAI B.1.22-1 in a letter dated October 15, 2004. In this letter, the applicant provided a commitment to submit a description of the Reactor Vessel Internals Cast Austenitic Stainless Steel Components Program, including its inspection plan, to the NRC staff for review and approval at least 24 months prior to entering the period of extended operation for ANO-2.

The staff concludes that the following technical and regulatory bases justify the acceptance of the Reactor Vessel Internals Cast Austenitic Stainless Steel Program, as discussed in Section B.1.22 of the ANO-2 LRA and amended in the applicant's response to RAI B.1.22-1 dated October 15, 2004:

1. The applicant will implement the AMP in accordance with the recommended guidance in GALL AMP XI.M13, "Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS)."

2. The applicant has committed to submit a description of the aging management program, including the inspection plan, for the RV internal CASS components for NRC review and approval at least 24 months prior to entering the extended period of operation for ANO-2. The staff has confirmed that the applicant has included this commitment in the Commitment Tracking List for the ANO-2 LRA.

3. The applicant's commitment will provide the NRC with an opportunity to review the inspection program for the RV internal CASS components and to resolve any potential issues that may develop during the staff's review of the program. The staff considers 24 months to be sufficient evaluation time for reviewing the program and inspection plan and for addressing any issues that may develop during the review process.

To obtain NRC staff approval its proposed inspection plan regarding CASS components prior to entering the period of extended operation for ANO-2, the applicant must submit a license amendment request. After the NRC staff's approval of the inspection plan, any future changes to the inspection plan will be evaluate in accordance with 10 CFR 50.59.

Similarly, since the details of the Reactor Vessel Internals Stainless Steel Plates, Forgings, Welds and Bolts Program have yet to be developed, including the details on location of components for examination, inspection methods and qualifications, and frequency of examinations, the scope of the AMP has yet to be finalized. The staff therefore issued RAI B.1.23-1 and requested that the applicant formally make a commitment to submit a description of the program, including its inspection plan, to the NRC for review and approval no later than three years prior to the period of extended operation.

The applicant responded to RAI B.1.23-1 in a letter, dated October 15, 2004. In this letter, the applicant provided a commitment to submit a description of the Reactor Vessel Internals Stainless Steel Plates, Forgings, Welds, and Bolting Program, including the inspection plan, to the staff for review and approval at least 24 months prior to entering the period of extended operation for ANO-2.

The staff concludes that the following technical and regulatory bases justify the acceptance of the Reactor Vessel Internals Stainless Steel Plates, Forgings, Welds, and Bolting Program, as discussed in Section B.1.23 of the ANO-2 LRA and amended in the applicant's responses to RAI B.1.23-1 dated October 15, 2004:

1. The applicant will implement the AMP in accordance with the recommended guidance in GALL AMP XI.M16, "PWR Vessel Internals."

2. The applicant has committed to submit a description of the management program, including the inspection plan, for the RV internal stainless steel plate, forging, weld and bolting components for NRC review and approval at least 24 months prior to entering the extended period of operation for ANO-2. The staff has confirmed that the applicant has included this commitment in the Commitment Tracking List for the ANO-2 LRA.

3. The applicant's commitment will provide the NRC with an opportunity to review the inspection program for the RV internal stainless steel plate, forging, weld and bolting components and to resolve any potential issues that may develop during the staff's review of the program. The staff considers 24 months to be sufficient evaluation time for reviewing the program and inspection plan and for addressing any issues that may develop during the review process.

To obtain NRC staff approval its proposed inspection plan regarding Reactor Vessel Internals prior to entering the period of extended operation for ANO-2, the applicant must submit a license amendment request. After the NRC staff's approval of the inspection plan, any future changes to the inspection plan will be evaluate in accordance with 10 CFR 50.59.

3.0.3.1.2 Reactor Vessel Head Penetration Program

The applicant credits the Reactor Vessel Head Penetration Program with the management of cracking in the upper vessel head penetration (VHP) nozzles adjoined to the upper RV head for ANO-2. The applicant describes the Reactor Vessel Head Penetration AMP in LRA Section B.1.20. The applicant stated that the purpose of the Reactor Vessel Head Penetration AMP is to manage PWSSC-induced cracking of the nickel-based alloy upper VHP nozzles to assure that the pressure boundary function is maintained during the period of extended operation.

The applicant identified that the ANO-2 Reactor Vessel Head Penetration AMP is an existing AMP whose program attributes are consistent with the comparable program attributes in GALL AMP XI.M11, "Nickel-Alloy Nozzles and Penetrations," without any enhancements or exceptions. The applicant also provided an applicable UFSAR Supplement summary description for the Reactor Vessel Head Penetration AMP in Section A.2.1.21 of the ANO LRA.

Staff Evaluation

The staff evaluated the Reactor Vessel Head Penetration AMP against the corresponding program elements in GALL AMP XI.M11, "Nickel-Alloy Nozzles and Penetrations." GALL Section XI.M11 currently relies on the staff's original Alloy 600 inspection program recommendations provided in GL 97-01, "Degradation of Control Rod Drive Mechanism Nozzle and Other Vessel Head Penetrations," issued on April 1, 1997. However, between November 2000 and April 2001 and subsequent to the issuance of GL 97-01, reactor coolant pressure boundary (RCPB) leakage was identified from the vessel head penetration (VHP) nozzles adjoined to the upper RV heads of four U.S. PWR-design light water reactor facilities. In NRC Bulletin 2001-01, "Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles," issued on August 3, 2001, the staff discussed the generic safety significance and impacts of these cracks on RVH penetration nozzles and recommended that enhanced visual examination or volumetric examination methods be used for the inspection of RVH penetration nozzles. In March 2002, during a refueling outage at the Davis-Besse Nuclear Power Station, the licensee for the plant reported the identification of reactor coolant leakage from RVH penetration nozzles. On March 18, 2002, the staff issued NRC Bulletin 2002-01, "Reactor Pressure Vessel Head Degradation and Reactor Coolant Pressure Boundary Integrity," to owners of PWR pressure vessels, requesting that the licensees address the impact of the Davis-Besse event on the structural integrity of their RVHs and associated penetration nozzles. On August 9, 2002, the staff issued NRC Bulletin 2002-02, "Reactor Pressure Vessel Head and Vessel Head Penetration Nozzle Inspection Programs," to address additional technical issues resulting from the Davis-Besse event. In NRC Bulletin 2002-02, the staff specifically suggested that further augmented inspections, more comprehensive than those suggested in NRC Bulletin 2001-01, be performed on RV head penetration nozzles.

The applicant stated that the Corrective Action Program was used to incorporate industry operating experience in order to develop inspections specific to ANO-2. Entergy Letter No. 0CAN040201, dated April 1, 2002, "15-Day Response to NRC Bulletin 2002-01, Reactor Pressure Vessel Head Degradation and Reactor Coolant Pressure Boundary Integrity," provided Entergy's response to the NRC regarding potential VHP nozzle and RV head degradation issues applicable to ANO-2. An assessment of the examination of ANO-2 upper VHP nozzles was completed during refueling outage (RFO) No. 2R15 in 2002. This assessment concluded that the examination of the ANO-2 upper VHP nozzles during RFO No. 2R15 was performed in accordance with the commitments stated in Entergy's response to NRC Bulletin 2001-01 for ANO-2.

On February 11, 2003, the NRC issued Order EA-03-009 to all holders of operating licenses for pressurized light-water reactors (PWRs). This NRC order superceded NRC Bulletins 2001-01 and 2002-01, and required that licensees assess the susceptibility of the RV head to PWSCC-related degradation. The Order also required licensees to perform augmented inspections for the reactor pressure vessel head based upon the susceptibility to PWSCC. The NRC amended EA-03-009 in a second order dated February 20, 2004, to more clearly define the applicable

requirements and to clarify which locations of the upper VHP nozzles were subject inspection (henceforth NRC Order EA-03-009, as amended, will be referred to as "the Order, as amended"). The staff therefore included Entergy Operations Inc., (Entergy's) responses to the Order, as amended, within the scope of its review of the ANO-2 Reactor Vessel Head Penetration AMP.

In RAI B.1.20-1, the staff requested additional clarification on the status of the applicant's implementation of the Order, as amended, for ANO-2. In response to RAI B.1.20-1, the applicant stated that issues that are relevant to current plant operation are being addressed by the existing regulatory process within the present license term rather than deferred until the time of license renewal. Consequently, the existing regulatory process provides assurance that ongoing interaction between Entergy and the NRC staff is occurring to ensure appropriate measures are included in the Reactor Vessel Head Penetration Program in response to the Order, as amended, and subsequent relevant industry experience and regulatory requirements.

In addition, the applicant stated that the Reactor Vessel Head Penetration Program identifies both visual and volumetric examination in accordance with the requirements of the Order, as amended, and will be modified as appropriate to include measures taken to implement evolving commitments in response to industry experience and regulatory requirements.

The actions that were required by the Order, as amended, have been evaluated by the staff. The bases for the staff's acceptance of the applicant's request for relaxation of certain requirements of the Order, as amended, are provided in NRC safety evaluations dated October 2, 2003 (Vent Line Nozzle Relaxation Approval), October 9, 2003 (CEDM Nozzles Relaxation Approval), October 9, 2003 (Incore Instrumentation Nozzles Relaxation Approval), and October 9, 2003 (Bare Metal Visual Relaxation Approval). Therefore, the staff finds the applicant's response to RAI B.1.20-1 and the applicant's Reactor Vessel Head Penetration AMP are acceptable and considers this issue closed.

FSAR Supplement

The applicant provided the following UFSAR Supplement summary description for the Reactor Vessel Head Penetration Program in Section A.2.1.21 of the ANO-2 LRA:

> The Reactor Vessel Head Penetration Program manages cracking of nickel based alloy reactor vessel head penetrations exposed to borated water to assure that the pressure boundary function is maintained. The program consists of both visual and volumetric examinations in accordance with NRC Order EA-03-009. In addition, the program includes ANO-2 commitments in response to NRC Generic Letter 97-01. The program will be modified as appropriate to implement evolving commitments in response to industry experience and regulatory requirements. The Inservice Inspection (Section A.2.1.15) and Water Chemistry Control Programs (Section A.2.1.33) are used in conjunction with this program to manage cracking of the reactor vessel head penetrations.

The applicant's FSAR Supplement summary description for the Reactor Vessel Head Penetration Program is consistent the applicant's obligations imposed by the Order, as amended. Since the FSAR Supplement summary description is current with the CLB for the

facility, the staff finds the FSAR Supplement summary description for the Reactor Vessel head Penetration Program to be acceptable.

Conclusion

The staff has reviewed the Reactor Vessel Head Penetration Program, as discussed in Section B.1.20 of the ANO-2 LRA. On the basis of its review of the applicant's program, as described above, the staff finds that those portions of the program for which the applicant claims consistency with the GALL program are consistent with the GALL program. In addition, for the reasons set forth above, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the UFSAR Supplement summary description for this AMP, as described in Section A.2.1.21 of the ANO-2 LRA, and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

For all the other AMP's reviewed in this section, the staff confirmed the applicant's claim of consistency. Details of the staff's evaluation of the audit and review are documented in the ANO-2 Audit and Review Report. The staff determined that these AMPs are consistent with the AMPs described in the GALL Report, including the associated operating experience attribute.

In Appendix A of the LRA, the applicant provided the Updated Final Safety Analysis Report (UFSAR) supplement required by 10 CFR 54.21(d). The applicant will incorporate the information presented in Appendix A into the UFSAR as Chapter 18 following the issuance of the renewed operating licenses. The staff reviewed the information in Appendix A and verified that the information in the UFSAR supplement provides an adequate summary of the program activities. The staff reviewed the following sections of Appendix A of the LRA.

- Section A.2.1.5 of the LRA for the Cast Austenitic Stainless Steel (CASS) Evaluation Program
- Section A.2.1.6 of the LRA for the Containment Leak Rate Program
- Section A.2.1.8 of the LRA for the Environmental Qualification (EQ) of Electric Components Program
- Section A.2.1.12 of the LRA for the Flow-Accelerated Corrosion Program
- Section A.2.1.16 of the LRA for the Non-EQ Inaccessible Medium-Voltage Cable Program
- Section A.2.1.17 of the LRA for the Non-EQ Insulated Cables and Connections Program
- Section A.2.1.21 of the LRA for the Reactor Vessel Head Penetration Program
- Section A.2.1.23 of the LRA for the Reactor Vessel Internals Cast Austenitic Stainless Steel Components Program

- Section A.2.1.24 of the LRA for the Reactor Vessel Internals Stainless Steel Plates, Forgings, Welds, and Bolting Program
- Section A.2.1.26 of the LRA for the Steam Generator Integrity Program
- Section A.2.1.27 of the LRA for the Structures Monitoring – Masonry Wall Program
- Section A.2.1.28 of the LRA for the Structures Monitoring – Structures Monitoring Program
- Section A.2.1.33 of the LRA for the Water Chemistry Control – Primary and Secondary Water Chemistry Control Program

The applicant provided the following UFSAR Supplement summary description for the Reactor Vessel Internal Cast Austenitic Stainless Components AMP in Section A.2.1.23 of the ANO-2 LRA:

> The Reactor Vessel Internals Cast Austenitic Stainless Steel (CASS) Program will manage aging effects of cast austenitic stainless steel reactor vessel internals components. This program will supplement the reactor vessel internals inspections required by the ASME Section XI Inservice Inspection Program. The program will manage cracking, reduction of fracture toughness, and dimensional changes using inspections of applicable components which will be determined based on the neutron fluence and thermal embrittlement susceptibility of the component. The Reactor Vessel Internals Cast Austenitic Stainless Steel Program will be initiated prior to the period of extended operation.

The applicant provided the following UFSAR Supplement summary description for the Reactor Vessel Internals Stainless Steel Plates, Forgings, Welds, and Bolting Program in Section A.2.1.24 of the ANO-2 LRA:

> The Reactor Vessel Internals Stainless Steel Plates, Forgings, Welds, and Bolting Program will manage aging effects of reactor vessel internals plates, forgings, welds, and bolting. This program will supplement the reactor vessel internals inspections required by the ASME Section XI Inservice Inspection Program. This program will manage the effects of crack initiation and growth due to stress corrosion cracking or irradiation assisted stress corrosion cracking, loss of fracture toughness due to neutron irradiation embrittlement, and distortion due to void swelling. This program will provide visual inspections and non-destructive examinations of reactor vessel internals. The Reactor Vessel Internals Stainless Steel Plates, Forgings, Welds, and Bolting Program will be initiated prior to the period of extended operation.

The staff noted that the water chemistry system and the enhanced examination of non-bolted components are not discussed In LRA UFSAR Supplement, Section A.2.1.24 as is recommended in NUREG-1800, Table 3.1-2, page 3.1-27, for GALL AMP XI.M16, "PWR Vessel Internals." In RAI B.1.23-2, the staff requested that the applicant revise LRA Section A.2.1.24 to be consistent with Table 3.1-2 of NUREG-1800 (page 3.1-27).

In response to RAI B.1.23-2 the applicant stated that control of ANO-2 primary water chemistry in accordance with the appropriate EPRI guidelines is discussed in the Water Chemistry Control Program section of the UFSAR Supplement, Section A.2.1.33. As indicated in LRA Table 3.1.2-2, the Water Chemistry Control Program applies to reactor vessel internals items. Therefore, UFSAR Supplement Section A.2.1.33. is an acceptable alternative summary description for describing the mitigative effect of the Water Chemistry Program on potential corrosive degradation mechanisms for the RV internal components.

On the basis of its audit, the staff finds that those programs for which the applicant claimed consistency with the GALL Report are consistent with the AMPs described in the GALL Report. Details of the staff's evaluation of the audit and review are documented in the ANO-2 Audit and Review Report.

The staff concludes that for the AMPs listed above, the applicant has demonstrated that the effects of aging can be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff reviewed the associated UFSAR supplements for these AMPs and concludes that the UFSAR supplements provide an adequate summary description of the programs, as required by 10 CFR 54.21(d).

3.0.3.2 AMPs that are Consistent with the GALL Report with Exceptions and/or Enhancements

In Appendix B of the LRA, the applicant indicated that the following AMPs were consistent with the GALL Report with exceptions and/or enhancement.

- Boric Acid Corrosion Prevention Program (B.1.3)
- Buried Piping Inspection Program (B.1.4)
- Diesel Fuel Monitoring Program (B.1.7)
- Fatigue Monitoring Program (B.1.9)
- Fire Protection and Fire Water System Program (B.1.10.1 and B.1.10.2)
- Reactor Vessel Integrity Program (B.1.21)
- Service Water Integrity Program (B.1.24)
- Water Chemistry Control - Closed Cooling Water Chemistry Control Program (B.1.30.2)

For AMPs that the applicant claimed are consistent with the GALL Report with exceptions and/or enhancement, the staff performed an audit to determine whether those elements or features of the program for which the applicant claimed consistency with the GALL Report were indeed consistent. Furthermore, the staff reviewed the exceptions and/or enhancement and its justification to determine whether the AMP, with the exceptions and/or enhancement, remains adequate to manage the aging effects for which it is credited. Details of the staff's evaluation of the audit and review are documented in the ANO-2 Audit and Review Report. The staff also reviewed the exceptions and/or enhancements to the GALL Report to determine whether they were acceptable. The results of the staff's audit and review are documented in the following sections of this SER.

3.0.3.2.1 Boric Acid Corrosion Prevention Program

Summary of Technical Information

The applicant credits the Boric Acid Corrosion Prevention Program with aging management of boric acid-induced corrosion of carbon steel and low alloy steel components and discusses this program is Section B.1.3 of the ANO-2 LRA. The applicant identified this program as a program that was consistent with the GALL Report and stated that this program was consistent with the corresponding program discussed in GALL AMP XI.M10, "Boric Acid Corrosion," with the following enhancements:

- The program scope will be revised to include identification and evaluation of the effects of borated water leakage on electrical components in addition to ferritic steel.

- The program acceptance criteria will be revised to address electrical components in addition to ferritic steel.

The applicant also include an applicable UFSAR Supplement summary description for the Boric Acid Corrosion Prevention Program in Section A.2.1.3 of the ANO-2 LRA.

Staff Evaluation

The staff reviewed the information provided in Section B.1.3 of Appendix B to the LRA and compared the program description for the Boric Acid Corrosion Prevention Program to the 10

program elements in GALL AMP XI.M10, "Boric Acid Corrosion," which provide detailed programmatic characteristics and criteria that the staff considers to be necessary to manage boric acid-induced corrosion of low alloy steel and carbon steel RCS components.

In RAI B.1.3-1, the staff requested that the applicant provide the basis for the proposed acceptance criteria that will be developed as part of the following enhancement to the Boric Acid Corrosion Prevention AMP:

- The program scope will be revised to include identification and evaluation of the effects of borated water leakage on electrical components in addition to ferritic steel.

- The program acceptance criteria will be revised to address electrical components in addition to ferritic steel.

In response to RAI B.1.3-1, the applicant stated that NUREG-1801 will be the basis for the acceptance criteria for electrical components exposed to boric acid. In accordance with "Acceptance Criteria" of NUREG-1801, Section XI.M10, acceptance criteria will be the absence of any detected leakage or crystal buildup. If identified during inspections, evidence of leakage or crystal buildup will be evaluated to determine the need for corrective actions prior to continued service. The acceptance criteria will apply to electrical components as well as ferritic steel components. The staff finds the response acceptable and considers this issue closed.

The applicant retains the program description of the Boric Acid Corrosion Prevention Program, as well as the descriptions of the program's 10 elements, on record at the ANO-2 facility.

Operating Experience

In the Operating Experience Section of B.1.3, Boric Acid Corrosion Prevention, the applicant states that recent industry events regarding RV head degradation required assessments at each ANO site to ensure that the Boric Acid Corrosion Prevention Programs for ANO-1 and ANO-2 are adequate and functioning effectively. The applicant also states that a self assessment was performed in February 2003, and no significant findings were identified during this assessment. In RAI B.1.3-2, the staff requested additional information on how program revisions have incorporated lessons learned from the Davis Besse vessel head degradation and the control rod drive mechanism penetration cracking discussed in Bulletins 2001-01, 2002-01, 2002-02, and Order EA-03-009. The staff also requested a discussion on implementation of corrective actions in the program which would prevent reoccurrences of degradation caused by boric acid leakage, as addressed in Generic Letter 88-05.

In response to B.1.3-2 the applicant stated that the Boric Acid Corrosion Prevention Program addresses the loss of material of carbon and low-alloy steel components exposed to a treated (borated) water environment. An assessment performed in 2003 concluded that the ANO-2 Boric Acid Corrosion Prevention Program was sufficient to detect loss of material by boric acid wastage of the RV head in the event of leaking CEDM penetrations. However, ANO-2 does not rely on leak detection through the Boric Acid Corrosion Prevention Program to manage cracking of CEDM penetrations. The ANO-2 Reactor Vessel Head Penetration Program described in Section B.1.20 of the LRA addresses RV head degradation and CEDM penetration cracking as discussed in the referenced NRC Bulletins and NRC Order EA-03-009. Measures

taken in response to NRC Order EA-03-009 and its successors carry forward into the period of extended operation.

The applicant also stated that the ANO-2 Boric Acid Corrosion Prevention Program is consistent with NUREG-1801, Section XI.M.10 and ANO-2 commitments in response to NRC Generic Letter 88-05. ANO-2 applies the requirements of 10 CFR 50, Appendix B to the Boric Acid Corrosion Prevention Program through the ANO-2 Corrective Action Program.

It should be noted that NRC Bulletin 2004-01, "Inspection of Alloy 82/182/600 Materials Used in the Fabrication of Pressurizer Penetrations and Steam Space Piping Connections at Pressurized-Water Reactors," was issued on May 28, 2004. Bulletin 2004-01 summarizes industry experience, and has demonstrated that Alloy 600 base metal and Alloy 82/182 weld components used in pressurizer penetration nozzles and steam space piping connections may be susceptible to PWSCC and consequential reactor coolant leakage.

The staff and the industry are currently pursuing resolution of the issues raised and discussed in NRC Bulletin 2004-01 on PWSCC and reactor coolant leakage in pressurizer penetration nozzles and steam space piping connections. Because this is an emerging issue that has yet to be resolved, but will be resolved during the current operating terms for ANO-2, consideration of these issues is beyond the scope of this license renewal review, pursuant to 10 CFR54.30(b).

On the basis of its review of the above operating experience and on discussions with the applicant's technical staff, the staff concludes that AMP B.1.3 adequately manages the aging effects that have been observed at the applicant's plant.

UFSAR Supplement

The applicant provided the following UFSAR Supplement summary description for the Boric Acid Corrosion Prevention Program in Section A.2.1.3 of the ANO-2 LRA:

> The Boric Acid Corrosion Prevention Program relies on implementation of recommendations of NRC Generic Letter (GL) 88-05 to monitor the condition of ferritic steel and electrical components on which borated water may leak. The program will detect borated water leakage by periodic visual inspection of borated water containing systems for deposits of boric acid crystals and the presence of moisture. This program will manage loss of material, loss of mechanical closure integrity, and corrosion of connector surfaces.

The applicant's program description for the Boric Acid Corrosion Prevention Program is consistent with the corresponding FSAR Supplement summary description for GALL AMP XI.M10, "Boric Acid Corrosion," as described in Table 3.1-2 of the SRP-LR, and is therefore acceptable.

Conclusion

The staff has reviewed the Boric Acid Corrosion Prevention Program, as discussed in Section B.1.3 of the ANO-2 LRA. The staff finds this AMP acceptable because the program has been effectively managing aging effects in all applicable SSCs constructed of carbon steel, low-alloy steel, and other susceptible materials that may be affected by borated water leakage. On the

basis of its review of the applicant's program, the staff finds that those portions of the for which the applicant claims consistency with the GALL program are consistent with the GALL program. In addition, the staff has reviewed the enhancements to the GALL program and finds that the applicant has demonstrated that the effects of aging can be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the UFSAR Supplement summary description for this AMP, as described in Section A.2.1.3 of the ANO-2 LRA, and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.2 Buried Piping Inspection

Summary of Technical Information in the Application

The applicant's buried piping inspection program is described in LRA Section B.1.4, "Buried Piping Inspection." In the LRA, the applicant stated that this is a new program that will be initiated prior to the period of extended operation. This program will be consistent, with exceptions, with GALL AMP XI.M34, "Buried Piping and Tanks Inspection." This AMP is credited with preventive measures to mitigate corrosion and with inspections to manage the effects of corrosion on the pressure-retaining capability of buried carbon steel components.

Staff Evaluation

During its audit and review, the staff confirmed the applicant's claim of consistency with the GALL Report. Details of the staff's evaluation of the audit and review are documented in the ANO-2 Audit and Review Report. Furthermore, the staff reviewed the exceptions and their justifications to determine whether the AMP, with the exceptions, remains adequate to manage the aging effects for which it is credited.

In Appendix B, Section B.1.4, of the LRA, the applicant stated that the buried piping inspection program will include (a) preventive measures to mitigate corrosion and (b) inspections to manage the effects of corrosion on the pressure-retaining capability of buried carbon steel components. Preventive measures will be in accordance with standard industry practice for maintaining external coatings and wrappings. Buried components will be inspected when excavated during maintenance. With the following exceptions, which will be initiated prior to the period of extended operation, the applicant stated that the buried piping inspection program will be consistent with GALL AMP XI.M34:

Element: 1: Scope of Program
Exception: (1) Buried valves and bolting that are not included in the GALL AMP will be inspected as part of this AMP.
(2) Tanks will not be inspected.

Element: 4: Detection of Aging Effects
Exception: Buried components will be inspected only when excavated during maintenance activities, not based on a scheduled inspection frequency.

In the LRA, the applicant stated the buried piping inspection program will include buried valves and bolting that are not included in the GALL AMP. The applicant stated that the additional components are of the same material, exposed to the same environment, and are expected to have the same aging effects as the other components covered by this AMP. Thus, the effects of aging will be identified prior to loss of intended function regardless of component type. In addition, the applicant stated that there are no buried tanks subject to an AMR.

In addition, the buried piping inspection program will require inspections of the buried components only when excavated during maintenance activities, which is inconsistent with the GALL AMP. The applicant stated that excavating such components solely to perform inspections poses undue risk of damage to protective coatings. Operating experience shows that the frequency of excavating buried components for maintenance activities is sufficient to provide assurance that the effects of aging will be identified prior to loss of intended function.

The staff finds that including the buried valves and bolting within the program scope is acceptable because they are the same material, exposed to the same environment, and are expected to have the same aging effects as the carbon steel piping covered by the buried piping inspection program. Because none of the ANO-2 buried tanks are within the scope of license renewal and subject to an AMR, the staff finds excluding buried tanks for inspection to be acceptable as well.

The GALL Report program description in Section XI.M34 recommends further evaluation of an applicant's operating experience with buried components in determinations of the adequacy of this program element. The staff reviewed the ANO-2 operating experience with excavations over the past few years and, based on the review as well as the applicant's discussion of this exception in the LRA, the staff finds that the frequency of excavating buried components for maintenance activities will be sufficient to provide assurance that the effects of aging will be identified prior to loss of intended function. Excavating such components solely to perform inspections could pose undue risk of damage to protective coatings. The staff finds that this exception is acceptable.

On the basis of its review of this AMP, the associated engineering report, and the operating experience, the staff determined that the buried piping inspection program is consistent with the GALL Report and that the exceptions in the buried piping inspection program are acceptable.

Operating Experience

The applicant stated that there have been multiple excavations at the site which provide some plant-specific operating experience even though the buried piping inspection program is a new program.

The staff reviewed the documentation for multiple excavations performed at the site for several maintenance activities. These excavations indicate that corrosion has not been a problem.

During the audit, the staff asked the applicant to clarify and/or provide the operating experience reviews for new programs. In its response, the applicant stated that the plant corrective action program, which captures internal and external plant operating experience issues, provides assurance that operating experience will be reviewed and incorporated in the future to provide

objective evidence to support the conclusion that the effects of aging will be adequately managed.

On the basis of its review of the above operating experience and the applicant's response, and on discussions with the applicant's technical staff, the staff concludes that the buried piping inspection program will adequately manage the aging effects that have been observed at the applicant's plant.

UFSAR Supplement

In Appendix A, Section A.2.1.4, of the LRA, the applicant provided the UFSAR supplement for the buried piping inspection program. The staff reviewed this section and determined that the information in the UFSAR supplement provides an adequate summary of the program activities. The staff finds this section of the UFSAR supplement sufficient.

Conclusion

On the basis of its review and audit of the applicant's program, the staff finds that those elements of the program for which the applicant claimed consistency with the GALL Report program are consistent with the GALL Report program. In addition, the staff has reviewed the exceptions to the GALL Report program and finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the UFSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.3 Diesel Fuel Monitoring

Summary of Technical Information in the Application

The applicant's diesel fuel monitoring program is described in LRA Section B.1.7, "Diesel Fuel Monitoring." In the LRA, the applicant stated that the program is consistent with, but includes exceptions to, GALL AMP XI.M30, "Fuel Oil Chemistry Program." This AMP is credited with ensuring that adequate diesel fuel quality is maintained to prevent plugging of filters, fouling of injectors, and corrosion of the fuel systems.

Staff Evaluation

During its audit and review, the staff confirmed the applicant's claim of consistency with the GALL Report. Details of the staff's evaluation of the audit and review are documented in the ANO-2 Audit and Review Report. Furthermore, the staff reviewed the exceptions and their justifications to determine whether the AMP, with the exceptions, remains adequate to manage the aging effects for which it is credited.

In Appendix B, Section B.1.7, of the LRA, the applicant stated the following exceptions to GALL AMP XI.M30:

Element: 2: Preventive Actions
Exception: No additives are used (other than biocide) beyond what the refiner adds during production.

Elements: 3: Parameters Monitored/Inspected
6: Acceptance Criteria
Exceptions: (1) Only American Society for Testing Materials (ASTM) standard D 1796 is used for determination of water and sediment, rather than standards D 1796 and D 2709.
(2) The LRA AMP specifies the method of ASTM standard D 2276 with 0.8 μm filter, instead of the modified ASTM standard D 2276, Method A, with a 3 μm filter.

Element: 4: Detection of Aging Effects
Exception: The program does not include ultrasonic measurements of tank bottoms.

The GALL Report identifies the following criterion for the preventive actions program element associated with the exception taken:

> The quality of fuel oil is maintained by additions of biocides to minimize biological activity, stabilizers to prevent biological breakdown of the diesel fuel, and corrosion inhibitors to mitigate corrosion.

The applicant stated that the #2 diesel fuel used at ANO-2 contains a comprehensive additive package. On the basis of its review of operating experience for the ANO-2 diesel fuel monitoring program (see discussion below), the staff finds this exception to be acceptable.

The GALL Report recommended the following criteria: (1) ASTM standard D 4057 is used for guidance on oil sampling and (2) ASTM standards D 1796 and D 2709 are used for determination of water and sediment contamination in diesel fuel. The staff determined that of the three standards recommended by the GALL Report, only the guidance presented in ASTM standard D 1796 applies to fuel oils with the viscosity of that used at ANO-2, and therefore finds this exception to be acceptable.

The guidance in the GALL Report concerning the use of modified ASTM standard D 2276, Method A, recommends a maximum pore size for determination of particulates. Use of a filter with a smaller pore size would not increase the likelihood that aging effects would go undetected and thus potentially affect the ability of components to perform their intended functions consistent with the CLB during the period of extended operation. The staff finds that the applicant's use of ASTM standard D 2276, which specifies the use of a filter with a smaller 0.8 μm pore size than that recommended in ASTM standard D 2276, Method A, is acceptable since the use of a 0.8 μm filter is more conservative than use of the 3.0 μm filter specified in the GALL Report.

The GALL Report states that corrosion may occur at locations in which contaminants may accumulate, such as a tank bottom, and an ultrasonic thickness measurement of the tank bottom surface ensures that significant degradation is not occurring.

The staff reviewed recent fuel oil operating experience and determined that compliance with diesel fuel oil standards and periodic sampling provide assurance that fuel oil contaminants that cause degradation are below allowable limits. Specifically, the review of recent operating experience did not identify unacceptable levels of water, particulate contamination, or biological fouling in the fuel oil. A review of condition reports did not identify instances of fuel oil system component failures attributed to the condition of the fuel oil. Condition report trending data did not identify a need for improvements to this program. Quarterly assessments are performed to review diesel fuel quality parameters to ensure that acceptance criteria are being met and to identify early indications of problems. In addition, the applicant stated that internal surfaces of tanks that are drained for cleaning are visually inspected for degradation. Based on the above discussion, the staff finds that the exception to preclude ultrasonic measurements of tank bottoms is acceptable.

On the basis of its review of this AMP, the associated engineering report, and the operating experience, the staff determined that this AMP is consistent with the GALL Report and that the exceptions in the diesel fuel monitoring program are acceptable.

Operating Experience

The staff reviewed the operating experience for the diesel fuel monitoring program. The applicant stated that it had experienced fuel oil related problems in 1986. Significant program improvements were implemented as a result of these events. One of the recommendations addressed the addition of an oxidation inhibitor to stored fuel. This is consistent with the need for adding corrosion inhibitors.

The staff's review of recent operating experience did not identify unacceptable levels of water, particulate contamination, or biological fouling in the fuel oil. A review of condition reports did not identify instances of fuel oil system component failures attributed to the condition of the fuel oil. Condition report trending data did not identify a need for improvements to this program. In addition, the applicant stated that it will perform quarterly assessments to review diesel fuel quality parameters to ensure that acceptance criteria are being met and to identify early indications of problems.

On the basis of its review of the above operating experience and on discussions with the applicant's technical staff, the staff concludes that diesel fuel monitoring program adequately manages the aging effects that have been observed at the applicant's plant.

UFSAR Supplement

In Appendix A, Section A.2.1.7, of the LRA, the applicant provided the UFSAR supplement for the diesel fuel monitoring program. The staff reviewed this section and determined that the information in the UFSAR supplement provides an adequate summary of the program activities. The staff finds this section of the UFSAR supplement sufficient.

Conclusion

On the basis of its review and audit of the applicant's program, the staff finds that those elements of the program for which the applicant claimed consistency with the GALL Report program are consistent with the GALL Report program. In addition, the staff has reviewed the

exceptions to the GALL Report program and finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the UFSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.4 Fatigue Monitoring Program

Summary of Technical Information in the Application

The applicant's fatigue monitoring program is described in LRA Section B.1.9, "Fatigue Monitoring." In the LRA, the applicant stated that the program is consistent with, but includes exceptions to, GALL AMP XI.M1, "Metal Fatigue of Reactor Coolant Pressure Boundary." This AMP is credited with tracking the number of critical thermal and pressure transients for selected reactor coolant system components.

Staff Evaluation

During its audit and review, the staff confirmed the applicant's claim of consistency with the GALL Report. Details of the staff's evaluation of the audit and review are documented in the ANO-2 Audit and Review Report. Furthermore, the staff reviewed the exceptions and their justifications to determine whether the AMP, with the exceptions, remains adequate to manage the aging effects for which it is credited.

In Appendix B, Section B.1.9, of the LRA, the applicant stated the following exceptions to GALL AMP XI.M1:

Element: 2: Preventive Actions
Exception: The program only involves tracking the number of transient cycles.

Element: 4: Detection of Aging Effects
Exception: The program does not provide for periodic update of fatigue usage calculations. Corrective actions are initiated only when the number of accumulated cycles approaches the number of component design cycles.

The GALL Report states that maintaining the fatigue usage factor below the design code limit and considering the effect of the reactor water environment will provide adequate margin against fatigue cracking of RCS components due to anticipated cyclic strains.

The effect of the reactor water environment on fatigue is addressed as a TLAA in the LRA, Section 4.3.3.1 (Generic Safety Issue 190). The staff's evaluation of this is addressed in Section 4 of this SER.

The GALL Report states that the program provides for periodic update of the fatigue usage calculations. The applicant stated that updates of fatigue usage calculations, as recommended in the GALL Report, are not necessary unless the number of accumulated fatigue cycles approaches the number of assumed design cycles, and commits to implement corrective

actions at that time. This is an alternative method for ensuring that the design code limit is not exceeded.

On the basis of its review of this AMP, the associated engineering report, and the operating experience, the staff determined that this AMP is consistent with the GALL Report and that the exceptions in the fatigue monitoring program are acceptable.

Operating Experience

The staff reviewed operating experience for the fatigue monitoring program. The applicant issues quarterly reports documenting operating history, the total number of critical types of transients, and the design limits. Condition report trending data does not reveal a need for improvements to this program. The number of pressure and temperature transient cycles is monitored and periodically compared with the design cycle count, as required by the program, to ensure that fatigue-sensitive components do not exceed their allowable number of design cycles. Based on the above discussion, the staff finds the exception to preclude the periodic update of fatigue usage calculations and that corrective actions are initiated only when the number of accumulated cycles approaches the number of component design cycles to be acceptable.

On the basis of its review of the above operating experience and on discussions with the applicant's technical staff, the staff concludes that AMP B.1.9 is sufficient to support the management of the aging effects of fatigue that has been monitored and predicted at the applicant's plant.

UFSAR Supplement

In Appendix A, Section A.2.1.9, of the LRA, the applicant provided the UFSAR supplement for the fatigue monitoring program. The staff reviewed this section and determined that the information in the UFSAR supplement provides an adequate summary of the program activities. The staff finds this section of the UFSAR supplement sufficient.

Conclusion

On the basis of its review and audit of the applicant's program, the staff finds that those elements of the program for which the applicant claimed consistency with the GALL program are consistent with the GALL program. In addition, the staff has reviewed the exceptions to the GALL program and finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the UFSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.5 Fire Protection Program

The applicant's fire protection program is described in LRA Section B.1.10, "Fire Protection." The AMP comprises two programs: Fire Protection and Fire Water System. Each program is discussed below.

3.0.3.2.5.1 Fire Protection

Summary of Technical Information in the Application

The applicant's fire protection is described in LRA Section B.1.10.1, "Fire Protection." In the LRA, the applicant stated that the program is consistent with, but includes exceptions to, GALL program XI.M26, "Fire Protection." This AMP is credited with performing periodic inspections and functional tests of the fire barriers and a diesel-driven fire pump to ensure that the operability of the fire barriers is maintained and that the fire pump fuel supply line can perform the intended function, respectively.

Staff Evaluation

During its audit and review, the staff confirmed the applicant's claim of consistency with the GALL Report. Details of the staff's evaluation of the audit and review are documented in the ANO-2 Audit and Review Report. Furthermore, the staff reviewed the exceptions and their justifications to determine whether the AMP, with the exceptions, remains adequate to manage the aging effects for which it is credited.

In Appendix B, Section B.1.10.1, of the LRA, the applicant stated the following exceptions to GALL AMP XI.M26:

Element: 3: Parameters Monitored/Inspected

Exceptions:
(1) Fire doors are inspected and clearances checked annually, not bi-monthly.
(2) Function tests of fire doors are performed annually, not daily, weekly, or monthly.

Elements:
1: Scope
3: Parameters Monitored/Inspected
4: Detection of Aging Effects
5: Monitoring and Trending
6: Acceptance Criteria

Exception: This program is not necessary to manage aging effects on halon fire protection system components.

The GALL Report identifies the following criteria for the parameters monitored/inspected program element associated with those exceptions taken:

- Hollow metal fire doors are visually inspected at least once bi-monthly for holes in the skin of the door. Fire door clearances are also checked at least once bi-monthly as part of an inspection program.
- Function tests of fire doors are performed daily, weekly, or monthly (which may be plant-specific) to determine the operability of automatic hold-open, release, closing mechanisms, and latches.

The applicant stated that inspection intervals are determined by engineering evaluation to detect degradation of the fire doors prior to the loss of intended function. Interim Staff Guidance (ISG) 04 revised criteria for the GALL AMP XI.M26 parameters monitored/inspected program element to no longer require fire doors to be visually inspected or function tested on a specific frequency. Rather, the applicant can establish a plant-specific interval to determine whether the integrity of door surfaces and for clearances, with plant-specific inspection intervals to be determined by engineering evaluation to detect degradation of the fire doors. The applicant's program meets ISG-04. Therefore, the staff finds this exception to be acceptable.

The GALL Report identifies the following criteria for program elements: scope, parameters monitored/inspected, detection of aging effects, monitoring and trending, and acceptance criteria. These criteria are associated with the exception that the fire protection program is not necessary to manage the aging effects on halon fire protection system components:

(1) The scope of this program includes the management of the aging effects on the intended function of the halon/carbon dioxide fire suppression system.
(2) Periodic visual inspection and function tests are to be performed at least once every six months to examine the signs of degradation of the halon/carbon dioxide fire suppression system.

In LRA Section 3.3.2.1.6 and Table 3.3.2-6, the staff reviewed the halon fire protection and reactor coolant pump motor oil leakage collection system AMR. The applicant credited the *periodic surveillance and preventive maintenance program* with managing the aging effect of loss of material for the halon fire protection system components. The applicant credited the periodic surveillance and preventive maintenance and boric acid corrosion programs with managing the aging effect of loss of material for the RCP motor oil leakage collection system. The staff reviewed the periodic surveillance and preventive maintenance program and finds that its scope includes aging management of components in the halon fire protection and RCP motor oil leakage collection system.

On the basis of its review of the applicant's programs, the staff finds that the boric acid corrosion program and periodic surveillance and preventive maintenance program effectively manage the aging effect of loss of material on halon fire protection system components so that their intended functions will be maintained during the period of extended operation.

The staff concludes that the periodic surveillance and preventive maintenance program, in lieu of the fire protection program, adequately manage the aging effects of halon and RCP motor oil leakage collection system components during the period of extended operation.

On November 1 through 5 and 15 through 19, 2004, the NRC staff performed an AMP inspection at ANO-2. During the inspection, the NRC staff noted that replacement components for valve 2CV-5017-1 stored in the warehouse and required for cold shutdown repair were not included in the scope of license renewal. The inspection staff believed that these components should be in-scope for license renewal and referred to NRR for guidance.

NRR staff evaluated the post-fire cold shutdown replacement components (stem clamp key, stem clamp, set screw) for Low Pressure Safety Injection Valve 2CV-5017-1. During the ANO-2 - NRC License Renewal Aging Management Review Inspection (NRC Inspection Report 05000368/2004-007), conducted November 1-5, 2004, and November 15-19, 2004, the

inspectors questioned whether the components should be within the scope of license renewal since the components are safety-related, relied on to perform a function that demonstrates compliance with 10 CFR 50.48, and the status of the components staged in the warehouse for 10 CFR 50.48 use is passive. In response, the applicant conservatively elected to add the spare parts to the scope of license renewal. The applicant credited 10 CFR Part 50, Appendix B, Criterion XIII for managing the aging of the spare parts. The staff agreed that this program addresses the immediate and ongoing serviceability of the replacement components and will adequately manage the aging effects of the spare parts during the period of extended operation. This inspection issue is closed.

Operating Experience

The staff reviewed operating experience for the fire protection program. The applicant identified condition report trending data that discovered discrepancies with fire barrier components, and resolved the negative trend data and specific conditions by implementing revised design methods for sealing penetrations.

On the basis of its review of the above operating experience and on discussions with the applicant's technical staff, the staff concludes that AMP B.1.10.1 adequately manages the aging effects that have been observed at the applicant's plant.

UFSAR Supplement

In Appendix A, Section A.2.1.10, of the LRA, the applicant provided the UFSAR supplement for the fire protection program. The staff reviewed this section and determined that the information in the UFSAR supplement provides an adequate summary of the program activities. The staff finds this section of the UFSAR supplement sufficient.

Conclusion

On the basis of its review and audit of the applicant's program, the staff finds that those elements of the program for which the applicant claimed consistency with the GALL program are consistent with the GALL program. In addition, the staff has reviewed the exceptions to the GALL program and finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the UFSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.5.2 Fire Water System

Summary of Technical Information in the Application

The applicant's fire water system is described in LRA Section B.1.10.2, "Fire Water System." In the LRA, the applicant stated that the program is consistent with, but includes an exception and enhancement to, GALL AMP XI.M27, "Fire Service Water." This AMP is credited with performing periodic inspections and functional tests of the fire barriers and a diesel-driven fire

pump to ensure that the operability of the fire barriers is maintained and that the fuel supply line can perform the intended function, respectively.

Staff Evaluation

During its audit and review, the staff confirmed the applicant's claim of consistency with the GALL Report. Details of the staff's evaluation of the audit and review are documented in the ANO-2 Audit and Review Report. Furthermore, the staff reviewed the exception and its justification, and the enhancement, to determine whether the AMP, with the exception and enhancement, remains adequate to manage the aging effects for which it is credited.

In Appendix B, Section B.1.10.2, of the LRA, the applicant stated the following exception to GALL AMP XI.M27:

Element: 3: Parameters Monitored/Inspected

Exception: The applicant does not implement NRC Generic Letter (GL) 89-13, "Service Water System Problems Affecting Safety-Related Equipment," commitments in the fire water system program.

The GALL Report identifies the following criterion for the parameters monitored/inspected program element associated with the exception taken:

> GL 89-13 recommends periodic flow testing of infrequently used loops of the fire water system at the maximum design flow to ensure that the system maintains its intended function.

The applicant verifies that every fire main segment (excluding individual system supplies) is clear of obstruction by performing a full-flow test at least once every three years. ISG-04 revised criteria for the GALL AMP XI.M27 parameters monitored/inspected program element to no longer recommend use of GL 89-13 in determining the system's ability to maintain pressure and internal system corrosion conditions. Rather, ISG-04 recommends either periodic flow testing of the fire water system using the guidelines of National Fire Protection Association (NFPA) 25, Chapter 13, Annexes A and D, at the maximum design flow, or periodic wall thickness evaluations to ensure that the system maintains its intended function. On the basis of the applicant's commitment to test fire water system components in accordance with the applicable NFPA codes and standards, the staff finds that this exception meets the criteria of ISG-04 and is, therefore, acceptable.

In Appendix B, Section B.1.10.2, of the LRA, the applicant stated the enhancement to GALL AMP XI.M27:

Elements: 1: Scope of Program
4: Detection of Aging Effects

Enhancement A sample of sprinkler heads will be inspected using the guidance of NFPA 25, Section 2.3.3.1. The NFPA 25 also contains guidance to repeat this sampling every 10 years after the initial field service testing.

The GALL Report identifies the following criterion for the scope of program and detection of aging effects program elements associated with the enhancement:

> Sprinkler systems are inspected once every refueling outage to ensure that signs of degradation, such as corrosion, are detected in a timely manner.

ISG-04 revised criteria for the GALL AMP XI.M27 detection of aging effects program element to recommend sprinkler head inspections before the end of the 50-year sprinkler head service life and at 10-year intervals thereafter during the extended period of operation to ensure that signs of degradation are detected in a timely manner. On the basis of the revised GALL criteria in ISG-04 and the applicant's commitment to rely upon applicable codes and standards to develop test procedures, the staff finds this enhancement to be acceptable.

On the basis of its review of the fire protection and fire water system, the associated engineering report, and the operating experience, the staff determined that the fire protection program is consistent with the GALL Report and that the exceptions and enhancement in the fire protection program are acceptable.

Operating Experience

The staff reviewed operating experience for the fire water system program. Trending data did not identify a need for improvement to this program. The applicant has incorporated industry operating experience regarding the opening of "wet" fire protection systems. Operating experience shows that opening fire protection systems results in oxygenation of the water, leading to increased corrosion of the pipe. The applicant revised its quarterly test requirements for fire protection systems such that they will not open system piping during these tests. The staff reviewed the results and confirmed that no significant aging of fire protection components was identified in the review.

On the basis of its review of the above operating experience and on discussions with the applicant's technical staff, the staff concludes that AMP B.1.10.2 adequately manages the aging effects that have been observed at the applicant's plant or at other nuclear plants.

UFSAR Supplement

In Appendix A, Section A.2.1.10, of the LRA, the applicant provided the UFSAR supplement for the fire protection program. In Section A.2.1.11 the applicant provides the UFSAR supplement for the fire water system program. The staff reviewed these sections and determined that the information in the UFSAR supplements provides an adequate summary of the program activities. The staff finds these sections of the UFSAR supplement sufficient.

Conclusion

On the basis of its review and audit of the applicant's program, the staff finds that those elements of the program for which the applicant claimed consistency with the GALL Report program are consistent with the GALL Report program. In addition, the staff has reviewed the exceptions and enhancement to the GALL Report program and finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the UFSAR supplements for this AMP and finds that they provide an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.6 Reactor Vessel Integrity

Summary of Technical Information in the Application

The applicant credits the Reactor Vessel Integrity AMP with the monitoring of the fracture toughness properties for the ferritic (low alloy steel) base metal and weld materials in the ANO-2 RV. The applicant describes the Reactor Vessel Integrity AMP in Section B.1.21 of the ANO-2 LRA and identifies that the AMP is consistent with the program attributes discussed in GALL AMP XI.M31, "Reactor Vessel Surveillance," with the following enhancement:

- The ANO-2 specimen capsule withdrawal schedule will be revised to withdraw and test a standby capsule to cover the peak fluence expected through the end of the period of extended operation.

Staff Evaluation

Criteria for the first 40 years are specified in 10 CFR Part 50, Appendix H (henceforth Appendix H), "Reactor Vessel Materials Surveillance Program," for monitoring changes in the fracture toughness of ferritic materials in the reactor beltline region due to neutron irradiation and the thermal environment. Appendix H requires that the surveillance program design and withdrawal schedule for the RV surveillance capsules must meet the requirements of American Society for Testing and Materials (ASTM) E-185, "Standard Practice for Conducting Surveillance Tests for Light Water Cooled Nuclear Power Vessels."

Regulatory Guide (RG) 1.99, Revision 2, "Radiation Embrittlement of Reactor Vessel Materials (May 1988)," describes general procedures acceptable to the NRC staff for calculating the effects of neutron irradiation embrittlement of the low-alloy steels used for light-water-cooled RVs. Surveillance data from the Appendix H program are used in RG 1.99, Revision 2 calculations, if applicable. The surveillance data is monitored and trended in accordance with RG 1.99, Revision 2, and RG 1.190, "Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence (March 2001)". The fluence was calculated using the methodology reported in the Babcock and Wilcox report BAW-2241P-A, Revision 1, "Fluence and Uncertainty Methodologies," which was published in April 1999. This methodology has been approved by the NRC Division of Systems, Safety, and Analysis staff and meets the uncertainty requirements of RG 1.190.

The applicant's description of the Reactor Vessel Integrity Program also demonstrates that the program is designed and implemented in compliance with the requirements of 10 CFR Part 50, Appendix H, and ASTM E185-82, "Recommended Practice for Surveillance Tests for Nuclear Reactor Vessels", and discusses how the implementation of the AMP will be used to provide inputs to the structural integrity assessments required under the requirements of 10 CFR Part 50, Appendix G for upper shelf energy (USE) assessments and pressure-temperature (P-T) limit assessments, and the requirements of 10 CFR 50.61 for providing the RV with adequate protection against pressurized thermal shock (PTS) events.[1] However, the applicant did not include a revised RV surveillance capsule withdrawal schedule for ANO-2 to account for the impact of additional neutron fluence exposure that would result from operating through the period of extended operation. The staff is imposing a license condition on the Reactor Vessel Integrity Program to ensure that changes to the AMP, as made to accommodate the extended period of operation, will continue to be reviewed and approved by the staff. The details of this license condition are discussed in the staff's evaluation of the UFSAR Supplement summary description for this AMP, which follows directly after this section. With the addition of this license condition, the staff concludes that applicant's Reactor Vessel Integrity Program is consistent with GALL AMP XI.M31, and will continue to comply with the requirements of 10 CFR Part 50, Appendix H, as amended by the license condition and is acceptable.

Operating Experience

The design of the RV Integrity Program was originally reported to the NRC in Combustion Engineering Topical Report No. A-NLM-005, dated October 30, 1974 and the unirradiated, baseline test data for the ANO-2 RV base metal and weld materials were reported to the NRC in Combustion Engineering Topical Report No. TR-MCD-002, dated March 1976. This topical report indicated that the ANO-2 RV Integrity Program was designed with the RV surveillance capsules identified as Capsules W83, W97, W104, W263, W277 and W284. To date, the applicant has removed two surveillance capsules, Capsules W97 and W104 from the ANO-2 RV in compliance with its 10 CFR Part 50, Appendix H, program. The applicant reported the test results for the plates and welds in the capsules to the NRC in the following topical reports:

- Capsule W97 - data reported in a Batelle Topical Report that was submitted to the NRC in Arkansas Power and Light Company Letter No. 2CAN028503 (February 8, 1985).

- Capsule W104 - data report in Babcock and Wilcox Topical Report BAW-2399, *Analysis of Capsule W-104, Entergy Operations, Inc., Arkansas Nuclear One Unit 2 Power Plant* (September 2001).

The applicant's submittal of these topical reports complied with the test data reporting requirements of Section IV of 10 CFR Part 50, Appendix H.

Section 4.2 of the ANO-2 LRA demonstrates that the applicant has appropriately considered the applicable RV surveillance in the calculations for the TLAAs on neutron irradiation

[1] The data from implementation of the Reactor Vessel Integrity Program provide critical fracture toughness data inputs for the applicant's time-limited aging analyses (TLAAs) for USE, PTS, and P-T limits. Refer the staff's evaluations in Section 4.2 of this SER on the related TLAAs on USE, PTS, and P-T limits for the ANO-2 LRA.

embrittlement, including the TLAAs for pressurized thermal shock (PTS) calculations, upper shelf energy (USE) calculations, and pressure-temperature (P-T) limit calculations. This complies with applicable evaluation criteria in Paragraph §(c))(2) of 10 CFR 50.61 for the TLAA on PTS and in Paragraph §IV.A. of 10 CFR Part 50, Appendix G, for the TLAAs on USE and P-T limits. The staff's evaluations of the TLAAs on PTS, USE, and P-T limits are provided in Section 4.2 of this SER.

On the basis of the review of the above operating experience, the staff concludes that AMP B.1.21 will adequately manage the aging effects that have been observed at the applicant's plant or at other nuclear plants.

UFSAR Supplement

The applicant provides the following UFSAR Supplement summary description for the Reactor Vessel Integrity AMP in Section A.2.1.22 of the ANO-2 LRA:

> The Reactor Vessel Integrity Program manages reduction of fracture toughness of reactor vessel beltline materials to assure that the pressure boundary function of the reactor vessel is maintained. The program is based on ASTM E-185-82, "Standard Recommended Practice for Surveillance Tests for Nuclear Reactor Vessels," and includes an evaluation of radiation damage based on pre-irradiation and post irradiation testing of Charpy V-notch and tensile specimens. Through the Reactor Vessel Integrity Program, reports are submitted as required by 10CFR Part 50 Appendix H.

The applicant's UFSAR Supplement summary description for this AMP provides an acceptable general description of the Reactor Vessel Integrity AMP and the RV surveillance capsule withdrawal schedule for ANO-2 that is implemented as part of the AMP. However, the UFSAR Supplement summary description for this AMP does not include the specific surveillance capsule withdrawal schedule for the period of extended operation. The applicant has three standby capsules (capsules 4, 5, and 6) which can be repositioned to address the applicant's program enhancement. In RAI B.1.21-1, the staff requested that the applicant submit a specific RV surveillance capsule withdrawal schedule through the end of the period of extended operation for staff review and approval. In addition, the staff requested that the applicant revise the UFSAR Table 5.2-12 accordingly.

In response to RAI B.1.21-1, the applicant stated that Capsule 3 is scheduled to be removed at 30 effective full power years (EFPY). The applicant estimated that this capsule will receive approximately 4.9E19 n/cm^2 (E $\geq$ 1.0 MeV) at 30 EFPY, which is slightly less than the expected 48 EFPY fluence of 5.0E19 n/cm^2 (E $\geq$ 1.0 MeV) discussed in the ANO-2 LRA, Section 4.2.2. As discussed in Section B.1.21 of the ANO-2 LRA, the ANO-2 specimen capsule withdrawal schedule will be revised to withdraw and test a standby capsule to cover the peak fluence expected through the end of the period of extended operation. As specified in Note (a) to Table 5.2-12 in the ANO-2 LRA, if required, Capsules 4, 5, or 6 will be repositioned to address the applicant's program enhancement. Alternatively, Entergy may decide to delay the withdrawal of Capsule 3 to cover the period of extended operation and would, at that time, notify the NRC of the change to the withdrawal schedule as required by 10 CFR 50, Appendix H.

10 CFR Part 50, Appendix H, requires licensees to submit any proposed changes to their withdrawal schedules to the NRC for review and approval. As mentioned, Table 5.2-12 of the ANO-2 LRA contains a statement that says prior to changing removal intervals, NRC approval is required per 10 CFR 50, Appendix H.

To ensure that this requirement will carry forward after the ANO-2 operating license has been renewed, the staff will impose the following condition in the renewed license for ANO-2 that requires Entergy to submit any further changes to the surveillance capsule withdrawal schedule for NRC review and approval:

> All capsules in the reactor vessel that are removed and tested must meet the test procedures and reporting requirements of ASTM E 185-82 to the extent practicable for the configuration of the specimens in the capsule. Any changes to the capsule withdrawal schedule, including spare capsules, must be approved by the NRC prior to implementation. All capsules placed in storage must be maintained for future insertion. Any changes to storage requirements must be approved by the NRC.

With the addition of the license condition, the staff finds that the applicant's response to RAI B.1.21-1 and the Reactor Vessel Integrity Program are acceptable, and considers this issue closed.

Conclusion

The staff has reviewed the Reactor Vessel Integrity Program, as discussed in Section B.1.21 of the ANO-2 LRA. On the basis of its review of the applicant's program and with the addition of the license condition discussed above, the staff finds that those portions of the AMP for which the applicant claims consistency with the GALL program are consistent with the GALL program. In addition, the staff has reviewed the enhancements to the GALL program and finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the UFSAR Supplement summary description for this AMP, as described in Section A.2.1.22 of the ANO-2 LRA, and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.7 Service Water Integrity

Summary of Technical Information in the Application

The applicant's service water integrity program is described in LRA Section B.1.24, "Service Water Integrity." In the LRA, the applicant stated that the program will be consistent with, but include exceptions and an enhancement to, GALL program XI.M20, "Open-Cycle Cooling Water System." This AMP is credited with relying on surveillance and control techniques, based on the recommendations of NRC Generic Letter 89-13, to ensure that the effects of aging on the service water system will be managed for the period of extended operation.

Staff Evaluation

During its audit and review, the staff confirmed the applicant's claim of consistency with the GALL Report. Details of the staff's evaluation of the audit and review are documented in the ANO-2 Audit and Review Report.. Furthermore, the staff reviewed the exceptions and their justifications, and the enhancement, to determine whether the AMP, with the exceptions and enhancement, remains adequate to manage the aging effects for which it is credited.

In Appendix B, Section B.1.24, of the LRA, the applicant stated the exceptions to GALL AMP XI.M20:

Element: 2: Preventive Actions
Exception: The SWIP components are lined or coated only as deemed necessary, they are not all lined or coated.

Element: 5: Monitoring and Trending
Exception: The frequency of inspections and testing is established according to results, the frequency of these activities is not set to commence annually and during refueling outages.

The applicant stated that the service water integrity program uses lining or coating on components as deemed necessary, whereas GALL program XI.M20 requires the system components to be constructed of appropriate materials, and lined or coated for protection of the underlying metal components against aggressive cooling water environments. The applicant stated that it has conducted various inspections of components over time and either upgraded the material of the component such that no coating is required, or coated the components requiring lining or coating. The staff reviewed the service water integrity program and finds that this exception is acceptable.

The applicant stated that the service water integrity program varies the frequency of inspections and testing frequency according to results, whereas GALL program XI.M20 requires annual testing and testing during refueling outages. The staff finds that the difference in inspection and testing frequency is insignificant since aging effects typically manifest over several years. The inspection frequencies are determined based on engineering evaluation of inspection results and in accordance with the applicant's commitments under GL 89-13. The staff finds this exception to be acceptable.

In Appendix B, Section B.1.24, of the LRA, the applicant stated the enhancement to GALL AMP XI.M20:

Element: 4: Detection of Aging Effects
Enhancement: The program will check for evidence of selective leaching during visual inspections.

The GALL Report identifies the following criterion for the detection of aging effects program element associated with the enhancement:

> Inspections for biofouling, damaged coatings, and degraded material condition are conducted.

During the audit, the staff asked the applicant to provide the technical justification for performing visual inspections without hardness testing to detect selective leaching. In its response, the applicant stated that details on the enhancements to programs to manage loss of material due to selective leaching are provided in clarification letter 2CAN010401, dated January 22, 2004. The applicant committed to providing these details prior to the period of extended operation. The staff finds this acceptable.

On the basis of its review of this AMP, the associated engineering report, and the operating experience, the staff determined that this AMP is consistent with the GALL Report and that the exceptions and enhancement in the service water integrity program are acceptable.

Operating Experience

The staff reviewed correspondence and reports dealing with the applicant's response to GL 89-13 and subsequent activities related to the SW system. This included a sample of condition reports related to the SW system as well as periodic monitoring and trending data.

During the audit, the staff noted that the LRA indicates that minor through wall piping leaks have occurred and the service water components are routinely inspected to ensure loss of material and cracking will not degrade the ability of the service water system to perform its intended function. The staff asked the applicant to provide the type of inspection used to detect the aging effects of loss of material and cracking and the justification for the inspection method.

In its response, the applicant stated that details on the enhancements to programs to manage loss of material due to selective leaching are provided in clarification letter 2CAN010401, dated January 22, 2004. The applicant committed to providing these details prior to the period of extended operation. The staff finds this acceptable.

On the basis of the its review of the above operating experience and on discussions with the applicant's technical staff, the staff concludes that AMP B.1.24 adequately manages the aging effects that have been observed at the applicant's plant.

UFSAR Supplement

In Appendix A, Section A.2.1.25, of the LRA, the applicant provided the UFSAR supplement for the service water integrity program. The staff reviewed this section and determined that the information in the UFSAR supplement provides an adequate summary of the program activities. The staff finds this section of the UFSAR supplement sufficient.

Conclusion.

On the basis of its review and audit of the applicant's program, the staff finds that those elements of the program for which the applicant claimed consistency with the GALL Report program are consistent with the GALL Report program. In addition, the staff has reviewed the exceptions and enhancement to the GALL Report program and finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the UFSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.8 Closed Cooling Water Chemistry Control Program

Summary of Technical Information in the Application

The applicant's closed cooling water chemistry control program is described in LRA Section B.1.30.2, "Closed Cooling Water Chemistry Control." In the LRA, the applicant stated that the program is consistent with, but includes exceptions to, GALL program XI.M21, "Closed-cycle Cooling Water System". This AMP is credited with monitoring and inspecting chemistry parameters as preventive measures to manage loss of material, cracking, and fouling for closed cooling water system components.

Staff Evaluation

During its audit and review, the staff confirmed the applicant's claim of consistency with the GALL Report. Details of the staff's evaluation of the audit and review are documented in the ANO-2 Audit and Review Report. Furthermore, the staff reviewed the exceptions and their justifications to determine whether the AMP, with the exceptions, remains adequate to manage the aging effects for which it is credited.

The applicant states that it's closed cooling water chemistry control program includes preventive measures that manage loss of material, cracking, and fouling for component cooling water system components. These chemistry activities provide for monitoring and controlling component cooling water chemistry using ANO-2 procedures and processes based on EPRI TR-107396, "Closed Cooling Water Chemistry Guidelines."

In Appendix B, Section B.1.30.2, of the LRA, the applicant stated the exceptions GALL AMP XI.M21:

Element:	3: Parameters Monitored/Inspected 5: Monitoring and Trending 6: Acceptance Criteria
Exception:	The program only monitors chemistry parameters.
Element:	4: Detection of Aging Effects
Exception:	The program is a preventive program that claims no credit for the detection of aging effects through performance and functional testing.
Element:	6: Acceptance Criteria
Exception:	The nitrite corrosion inhibitor concentrations are maintained within specified limits, which allow for larger variance (1200 parts per million, or ppm - 4000 ppm) than recommended (500 ppm - 1000 ppm) in EPRI TR-107396.

The GALL Report identifies the following criteria for program elements: (1) parameters monitored/inspected, (2) monitoring and trending, and (3) acceptance criteria:

(1) The AMP monitors the effects of corrosion by surveillance testing and inspection in accordance with standards in EPRI TR-107396 to evaluate system and component performance. For pumps, the parameters monitored include flow and discharge and suction pressures. For heat exchangers, the parameters monitored include flow, inlet and outlet temperatures, and differential pressure.

(2) Performance and functional tests are performed at least every 18 months to demonstrate system operability, and tests to evaluate heat removal capability of the system and degradation of system components are performed every five years.

(3) System and component performance test results are evaluated in accordance with the guidelines of EPRI TR-107396. Acceptance criteria and tolerances are also based on system design parameters and functions.

The staff determined that EPRI TR-107396 does not recommend equipment performance and functional testing for monitoring the effectiveness of a water chemistry control program. Monitoring pump performance parameters is of little value in managing the effects of aging on long-lived, passive closed cooling water system components. EPRI TR-107396, Section 5.7, stated that performance monitoring is typically part of an engineering program, which would not be part of water chemistry. The report further stated that performance monitoring "...can be used to confirm that conditions in the closed cooling water system are not degrading heat exchanger performance...."

The staff finds that this EPRI guidance neither requires nor negates performance monitoring. The staff reviewed the applicant's procedure on chemistry inspections of plant systems and heat exchangers, and finds that implementation of this procedure enables the applicant to continue to confirm the effectiveness of the closed cooling water chemistry control program via plant inspections. The staff finds this exception to be acceptable.

The GALL Report identifies the following criterion for the detection of aging effects program element associated with the exception taken:

- The extent and schedule of inspections and testing, in accordance with EPRI TR-107396, assure detection of corrosion before the loss of intended function of the component. Performance and functional testing, in accordance with EPRI TR-107396, ensures acceptable functioning of the closed cooling water system or components serviced by the closed cooling water system.

The staff reviewed the applicant's implementation procedure which enables the applicant to confirm the effectiveness of the closed cooling water chemistry control program. Inspections are performed when systems are opened for maintenance, when an adverse trend exists, or when desired by the chemistry department. The component cooling water heat exchangers are inspected to assess the effectiveness of chemistry control every time the heat exchangers are put in wet lay-up. In the past three years, component cooling water heat exchangers have been inspected more than eight times. These inspections have been performed for many years.

The staff finds that aging effects on passive mechanical components in the closed cooling water system are adequately managed without reliance on performance and functional testing. Therefore, the staff finds this exception to be acceptable.

The GALL Report identifies the following criterion for the "acceptance criteria" program element associated with the exception taken:

- Corrosion inhibitor concentrations are maintained within the limits specified in the EPRI water chemistry guidelines for closed cooling water systems.

The staff noted that the applicant is currently drafting changes to a procedure to incorporate the EPRI guidelines on nitrite corrosion inhibitor. The procedure will specify that nitrite inhibitor concentrations are to be maintained in accordance with EPRI TR-107396.

By letter dated May 19, 2004, the applicant stated, in response to question B.1.30.2-5, that it had revised its procedure to incorporate the EPRI guidelines on nitrite corrosion inhibitor. Therefore, this is no longer an exception to the GALL program.

On the basis of the applicant's response, the staff finds this exception to no longer apply. The staff confirms that the acceptance criteria program element is consistent with the GALL Report with respect to nitrite corrosion inhibitor concentrations, and therefore, finds this to be acceptable.

On the basis of its review of this AMP, the associated engineering report, and the operating experience, the staff determined that this AMP is consistent with the GALL Report and that the exceptions in the closed cooling water chemistry control program are acceptable.

Operating Experience

The operating experience review, performed by the applicant, did not identify any condition reports or licensee event reports relating to chemical excursions in the systems covered under the closed cooling water chemistry control program . Also, the condition report trending data did not identify recurrent component degradation in the systems covered under this AMP. The review of condition reports, condition report trending data, and interviews with the plant technical staff confirmed the program requirements are effectively implemented.

On the basis of its review of the above operating experience and on discussions with the applicant's technical staff, the staff concludes that AMP B.1.30.2 adequately manages the aging effects that have been observed at the applicant's plant.

UFSAR Supplement

In Appendix A, Section A.2.1.32, of the LRA, the applicant provided the UFSAR supplement for the water chemistry control – closed cooling water chemistry control program, which states that the closed cooling water chemistry control program includes preventive measures that manage loss of material, cracking, and fouling, as applicable, for component cooling water system components. These chemistry activities provide for monitoring and controlling component cooling water chemistry using procedures and processes based on EPRI TR-107396, "Closed Cooling Water Chemistry Guidelines."

During the audit, the staff noted that for the closed cycle cooling water system described in the SRP-LR, Table 3.3-2, it is stated that "...The program relies on preventive measures to

minimize corrosion by maintaining inhibitors and by performing non-chemistry monitoring consisting of inspection and nondestructive evaluations based on the guidelines of EPRI-TR-107396 for closed-cycle cooling water systems." During the audit, in question B.1.30.2-7, the staff noted that the applicant neither referred to the inspections performed nor specified the exceptions to GALL AMP XI.M21, "Closed-Cycle Cooling Water System" in LRA Appendix A, Section A.2.1.32. The staff requested that the applicant revise the LRA Appendix A, Section A.2.1.32 to be consistent with the GALL Report, Table 3.3-2, or justify its acceptability (RAI B.1.30.2-1).

In its response dated May 19, 2004, the applicant stated LRA Section B.1.30.2 provides justification for the exceptions between the closed cooling water chemistry control program and GALL AMP XI.M21, including the exception for inspection and nondestructive evaluations; therefore additional information is not required. The applicant stated that the UFSAR Supplement, LRA, Appendix A, Section A.2.1.32 contains a summary description of the program as required by 10 CFR 50.54.21(d).

The staff reviewed the applicant's response and the UFSAR supplement and confirms that it provides an adequate summary description of the program, as identified in the SRP-LR UFSAR supplement table and as required by 10 CFR 54.21(d).

Conclusion

On the basis of its review and audit of the applicant's program, the staff finds that those elements of the program for which the applicant claimed consistency with the GALL Report program are consistent with the GALL Report program. In addition, the staff has reviewed the exceptions to the GALL Report program and finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the UFSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.3 AMPs that are Plant-Specific

In Appendix B of the LRA, the applicant indicated that the following AMPs were plant-specific:

- Alloy 600 Aging Management Program (B.1.1)
- Bolting and Torquing Activities Program (B.1.2)
- Heat Exchanger Monitoring Program (B.1.12)
- Inservice Inspection - Containment Inservice Inspection (CII) Program (B.1.13)
- Inservice Inspection - Inservice Inspection (ISI) Program (B.1.14)
- Oil Analysis Program (B.1.17)
- Periodic Surveillance and Preventive Maintenance Program (B.1.18)
- Pressurizer Examinations Program (B.1.19)
- System Walkdown Program (B.1.28)
- Wall Thinning Program (B.1.29)
- Water Chemistry Control - Auxiliary Systems Water Chemistry Control Program (B.1.30.1)

For AMPs that are not consistent with or not addressed by the GALL Report, the staff performed a complete review of the AMPs to determine if they were adequate to monitor or manage aging. The staff's review of these plant-specific AMPs is documented in the following sections of this SER.

3.0.3.3.1 Alloy 600 Aging Management Program

Summary of Technical Information in the Application

The applicant credits the Alloy 600 Aging Management Program with the management of the cracking due to primary water stress-corrosion cracking (PWSCC) in Alloy 600 and Alloy 690 components and Alloy 52/152 and Alloy 82/182 welds not covered by the applicant's Reactor Vessel Head Penetration Program or by the Steam Generator Integrity Program. The applicant discusses this program in Section B.1.1 of the ANO-2 LRA. The applicant's Reactor Vessel Head Penetration Program, AMP B.1.20, is credited with the management of cracking of the Alloy 600 RV head penetrations and the Steam Generator Integrity Program, AMP B.1.25, is credited with the management of cracking of the Alloy 690 steam generator tubes and plugs for the period of extended operation.

The applicant indicated that the Alloy 600 Aging Management Program is a plant-specific program for the ANO-2 LRA and discussed the AMP in terms of the 10 program elements recommended in NUREG-1800, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants" (SRP-LR) and the ability of this program to manage the applicable effects of aging. The applicant also included an applicable UFSAR Supplement summary description for the Alloy 600 Aging Management Program in Section A.2.1.1 of the ANO-2 LRA.

Staff Evaluation

The staff assessed the corrective actions, confirmation process, and administrative controls program attributes of the Alloy 600 Aging Management Program as part of the staff's assessment of the applicant's Quality Assurance Program, which is evaluated in Section 3.0.4 of this SER. The staff evaluation of the remaining program attributes for the ANO-2 Alloy 600 Management Program is given in the following evaluations.

[Program Scope] The scope of the Alloy 600 AMP includes the RCS piping, the pressurizer, the reactor pressure vessel, and the steam generators. The staff concludes that the program scope program attribute is acceptable because it includes ASME Code Class 1 Nickel-Alloy base metal and weld components in the scope of the program, including those used in the fabrication of the ANO-2 reactor vessel, pressurizer, RCS piping, and steam generator systems.

[Preventive Actions] The applicant stated that no actions are taken as part of this program to prevent aging effects or mitigate aging degradation. In RAI B.1.1-2, the staff noted that several preventive actions and common industry practices have been used to manage Alloy 600/82/182 PWSCC, and requested that the applicant provide a description of any preventive actions and/or water chemistry monitoring programs that ANO-2 is currently implementing that may be used to address the Alloy 600/82/182 cracking issue.

In response to RAI B.1.1-2, the applicant stated that ANO-2 has taken preventive actions to address the Alloy 600/82/182 cracking issue, however, these actions are not part of the Alloy 600 Aging Management Program. Various Alloy 600 pressurizer heater sleeves, instrument nozzles, and hot leg instrument nozzles have been repaired due to PWSCC. The repairs involve one of two methods, both of which remove Alloy 600 material from a pressure boundary function. One repair method replaces the Alloy 600 nozzles with Alloy 690 nozzles while the other utilizes no nickel-based alloy material in a pressure boundary role (i.e., the repairs involve installation of mechanical nozzle seal assemblies). Alloy 690 is an industry standard for replacement of Alloy-600 components. In addition, the ANO-2 Water Chemistry Control Program controls contaminants known to contribute to PWSCC. As described in Section B.1.30.3 of the LRA, the ANO-2 Primary Water Chemistry Control Program is based on EPRI TR-105714.

The applicant concludes that ANO-2 does take preventive actions to mitigate degradation of Alloy 600 components and Alloy 82/182 filler welds. Actions that are taken are consistent with industry practice and include maintenance of stringent water chemistry controls in accordance with industry accepted guidelines and replacement of faulty Alloy 600/82/182 components with materials significantly less susceptible to PWSCC. The staff finds the response acceptable and considers this issue closed.

[Parameters Monitored or Inspected] The applicant stated that the Alloy 600 Aging Management Program monitors the effect of PWSCC cracking using the examination and inspection requirements of the ASME Code, Section XI. The aging effects monitored by the Alloy 600 Aging Management Program are consistent with those evaluated and accepted by the staff in Sections 3.1.2.1.1, 3.1.2.1.3, and 3.1.2.1.4 of this SER. The aging effect monitored by the Alloy 600 Aging Management Program (i.e., cracking) is therefore acceptable to the staff.

[Detection of Aging Effects and Monitoring and Trending] The applicant stated that the Alloy 600 Aging Management Program will detect cracking by PWSCC prior to loss of component intended function. Selected Alloy 600, Alloy 52/152 and Alloy 82/182 locations receive examination in accordance with the requirements of the ASME Code, Section XI. The applicant stated that pressure measurement, vent, upper level, and temperature nozzles, heater sheaths, heater sleeves, and end plugs will receive visual examination (VT-2) from the exterior of the vessel in accordance with the requirements of the ASME Code, Section XI, Examination Category B-P. In RAI B.1.1-3, the staff noted that for many of these components the Alloy 600 pressure boundary welds are covered by insulation. Service experience has shown that early indications of through-wall leakage (e.g., boric acid on the component surface) are very difficult to detect when VT-2 examinations are performed with the insulation in-place. The staff requested that the applicant provide justification for not removing insulation when performing VT-2 examinations on the components mentioned above. The staff also requested that the applicant provide the frequency of inspection and the results of any volumetric non-destructive examination that has been performed.

In response to RAI B.1.1-3, the applicant stated that, as described in Section B1.1.4 on page B-12 of the LRA, the ANO-2 pressurizer heater and small-bore nozzles are visually inspected in addition to the ASME Code, Section XI, Examination Category B-P inspections. Insulation is removed if required to allow for bare metal examination of an area 360 degrees around the small nozzles and penetrations for evidence of boric acid residue. The inspections are

performed each refueling outage. The staff finds the response acceptable and considers this issue closed.

In the Alloy 600 Aging Management Program under the program attribute, "Detection of Aging Effects," the applicant states that guidance from the MRP in conjunction with the PWR owners groups will be used to identify critical locations for inspection and augmentation of existing ISI inspections at ANO-2 where appropriate. In RAI B.1.1-4, the staff requested that the applicant identify the date that ANO-2 commits to submit, for review and approval, an augmented aging management program that includes all recommendations from the industry's strategic plan, and meets the 10 elements in accordance with the guidance in NUREG-1800, Appendix A.1, "Aging Management Review - Generic," Table A.1-1, "Elements of an Aging Management Program for License Renewal." The staff noted that the date must be prior to the period of extended operation. The staff also noted that this commitment should be documented in the UFSAR.

In response to RAI B.1.1-4, the applicant stated that PWSCC of nickel-based alloys is a current license term issue. The applicant stated that issues that are relevant to current plant operation will be addressed by the existing regulatory process within the present license term rather than deferred until the time of license renewal. With regard to updating the UFSAR, the applicant stated that a commitment will be added to the UFSAR supplement. During development of the ANO-2 Alloy 600 Aging Management Program, the applicant stated that guidance developed by the EPRI MRP for the selection, inspection, and evaluation of nickel-based alloy components will be considered.

In RAI B.1.1-1, the staff requested that the applicant confirm that all of the components listed in the Alloy 600 Aging Management Program are covered under the ISI requirements of Section XI of the ASME Code. The staff also requested that the applicant identify any components that are not covered by the ASME Code, Section XI ISI requirements. In addition, the staff requested that the applicant provide a complete description of the proposed inspections including a technical justification for the inspection method and frequency for any components that are identified.

In response to RAI B.1.1-1, dated July 22, 2004 (refer to Entergy Letter No. 2CAN070405), the applicant stated that all nickel-based alloy items listed in Section B.1.1 of the LRA are included in the ANO-2 ISI Program with the exception of the thermal sleeves, the cladding on the pressurizer lower head, the RV lower shell and head, and the steam generator tubesheet, the steam generator channel head divider plate and primary nozzle rings, and the pressurizer heater support plates and heater support plate brackets. The applicant contends that the items that are inspected as part of the ANO-2 ISI Program have a greater susceptibility to PWSCC due to physical configuration or operational conditions (e.g., temperature) than those listed above, and the items listed above that are not volumetrically or visually inspected are bounded by the items that receive examinations in accordance with the ASME Code, Section XI. The applicant acknowledges that the EPRI Materials Reliability Project (MRP) in conjunction with the PWR owners groups is developing a strategic plan to manage PWSCC of nickel-based alloy components, and states that guidance developed by the MRP and the owners groups will be used to identify the need for augmenting existing ISI inspections at ANO-2 where appropriate.

The applicant also provided the following supplemental response to RAI B.1.1-1 in Entergy Letter No. 2CAN090402, dated September 10, 2004:

Primary water stress corrosion cracking (PWSCC) of nickel-based alloys is a current license term issue. As such, interaction between Entergy and the NRC Staff is ongoing to develop a program to manage the effects of aging due to this mechanism. In accordance with the statements of consideration, issues that are relevant to current plant operation are addressed by the existing regulatory process within the present license term rather than deferred until the time of license renewal. Consequently, the existing regulatory process provides assurance that aging effects caused by PWSCC of nickel-based alloys will be adequately managed during the period of extended operation. Consistent with all programs credited for license renewal at ANO-2, the Alloy-600 Program will be available on-site for NRC review. In addition, as requested by the NRC Staff, a description of the program will be submitted to the NRC for review and approval. The submittal date will be at least 24 months prior to the period of extended operation.

The applicant's descriptions for the Alloy 600 AMP, as discussed in Section B.1.1 of the ANO-2 LRA and in the applicant's responses to RAI B.1.1-1 dated July 22, 2004, and September 10, 2004, clarify two important attributes for the Alloy 600 AMP:

4. The applicant will participate in the EPRI-MRP's studies on PWSCC of ASME Code Class 1 Nickel-Alloy components and will use the guidance developed by the EPRI-MRP and the owners groups to identify the need for augmenting existing ISI inspections at ANO-2, where appropriate.

5. The applicant has committed to submitting an inspection plan for the ANO-2 ASME Code Class 1 Nickel-Alloy components to the staff for review and approval at least 24 months prior to entering the period of extended operation for the unit.

The staff has confirmed that the applicant manages PWSCC of the ANO-2 upper reactor vessel (RV) head penetration nozzles in accordance with a NRC-approved program that complies with the applicable augmented inspection requirements of NRC Order EA-03-009. This program is implemented through the applicant's Reactor Vessel Head Penetration Program. The staff has also confirmed that the applicant plans to manage PWSCC of Nickel-Alloy base metal and weld components in the pressurizer system in accordance with commitments made in the applicant's response to NRC Bulletin 2004-01, *Inspection of Alloy 82/182/600 Materials Used in the Fabrication of Pressurizer Penetrations and Steam Space Piping Connections at Pressurized Water Reactors (May 28, 2004).* This response is provided in Entergy Letter No. 0CAN070404, dated July 27, 2004.

For the remaining ASME Code Class 1 Nickel-Alloy components, the EPRI MRP's initiatives on PWSCC of ASME Code Class 1 Nickel-Alloy components are being performed to assess the need to implement augmented inspection of the components beyond those currently required by Section XI of the ASME Code, as invoked by 10 CFR 50.55a. The staff concludes that this is an acceptable process for managing aging in these components, because: (1) Entergy will apply acceptable industry guidelines that will ensure that only those inspections will be used that are capable of detecting degradation prior to a loss of component intended function, (2) it will allow the staff to review the applicant's inspection plans for these components as based on the industry recommendations, and (3) it will provide the staff an opportunity to resolve with the applicant any issues that may potentially arise with the inspection plan.

Records of the inspection program, examination and test procedures, examination/test data, and corrective actions taken are maintained in accordance with the requirements of ASME Section XI, Subsection IWA. The staff finds this approach acceptable since the ASME Code requires that the applicant maintain inspection records, and the corresponding corrective actions.

Based on the applicant's commitments for performing augmented inspections of the Alloy 82/182/600 materials used in the fabrication of the ANO-2 upper RV head penetration nozzles and pressurizer penetration nozzles and steam space piping components, and the applicant's commitment to submit an inspection plan for NRC review and approval 24 months prior to the entering the period of extended operation for the remaining Nickel-Alloy components, the staff concludes that the Detection of Aging Effects and Monitoring and Trending program attributes are acceptable. To obtain NRC staff approval of its proposed inspection plan regarding Nickel - Alloy components prior to entering the period of extended operation for ANO-2, the applicant must submit a license amendment request. After the NRC staff's approval of the inspection plan, any future changes to the inspection plan will be evaluated in accordance with 10 CFR 50.59.

[Monitoring and Trending] Records of the inspection program, examination and test procedures, examination/test data, and corrective actions taken are maintained in accordance with the requirements of ASME Section XI, Subsection IWA. The staff finds this approach acceptable since the ASME Code requires that the applicant maintain inspection records, and the corresponding corrective actions.

[Acceptance Criteria] The applicant stated that the acceptance standards specified in IWB-3500 will be applied to component locations that receive ASME Section XI volumetric, surface, and visual examinations. The applicant also stated that the acceptance criteria for visual inspections require that cognizant members of the system engineering, quality control and design engineering departments review the inspection results for indications of leakage. If abnormalities are identified, a condition report is issued. All through-wall pressure boundary leakage must be corrected prior to plant start-up. The staff notes that for the ASME Code Class 1 Alloy 600 components within the scope of the applicant's Alloy 600 Aging Management Program, the results of these industry initiatives may include recommendations for implementing more stringent alternative acceptance criteria to those currently required by Section XI of the ASME Code. These actions are consistent with current industry practices and the staff finds this to be acceptable.

[Operating Experience] The applicant stated that the Alloy 600 Aging Management Program is a new program for which there is no specific operating experience for ANO-2. The staff is aware of several reported cases of degradation in Alloy 600 weld components of other U.S. PWRs, including several reported cases of degradation in other Combustion Engineering (CE) Nuclear Steam Supply Systems (NSSS) design units. Specifically, PWSCC has been reported in Alloy 82/182 J-groove welds that are used to join Alloy 600 small bore nozzles to CE-designed pressurizers, steam generators, and/or hot legs. In RAI B.1.1-5, the staff noted that it is important for the applicant to review relevant industry service experience and incorporate lessons learned into the Alloy 600 program. Therefore, the staff requested that the applicant discuss what industry initiatives it plans to follow in order to incorporate experience related to Alloy 600 into the ANO-2 Alloy 600 AMP.

In response to RAI B.1.1-5, the applicant stated that, as defined in the Standard Review Plan (NUREG-1800), the Operating Experience program element describes the operating experience of the aging management program, including past corrective actions resulting in program enhancements or additional programs. Therefore, the applicant concluded that, as a new program, the ANO-2 Alloy 600 Aging Management Program has no relevant operating experience as defined in NUREG-1800. The applicant repeated its statement that guidance developed by the EPRI MRP and the PWR owners groups will be used to identify critical locations for inspection and augmentation of existing ISI inspections at ANO-2 where appropriate.

However, there is current generic operating experience that is applicable to the detection of PWSCC in the Alloy 82/182/600 components of the ANO-2 RCPB. These operating experience events that are discussed in NRC Order EA-03-009, and in NRC Bulletin 2004-01. The applicant is using its commitments made in response to the augmented inspection requirements of NRC Order EA-03-009 and Revision 1 of the Order and the Reactor Vessel Head Penetrations Program as the basis for managing PWSCC in the ANO-2 upper RV head penetration nozzles. These commitments are discussed and evaluated in Section B.1.20, *Reactor Vessel Head Penetration,* of this SER. The applicant is using its commitments that were made in response to NRC Bulletin 2004-01 as the basis for managing PWSCC in the ANO-2 pressurizer penetration nozzles. These commitments are identified in Entergy Letter No. 0CAN070404, *Response to NRC 2004-01 Regarding Inspection of Alloy 82/182/600 Materials Used in Pressurizer Penetrations and Steam Space Piping Components (July 27, 2004),* and include a commitment to perform bare-metal visual examinations of the Nickel-Alloy components in pressurizer penetrations during subsequent refueling outages, starting with refueling outage No. 17 in Spring 2005.

The staff concludes that the Operating Experience program attribute for the Alloy 600 Aging Management Program is acceptable because the applicant has addressed the safety implications of the generic operating experience and has used the experience to augment the inspection program for the upper RV head penetration nozzles, as required by NRC Order EA-03-009 and for Nickel-Alloy pressurizer penetration components, as recommended in NRC Bulleting 2004-01.

UFSAR Supplement

The applicant provides the following Updated Final Safety Analysis Report summary description for the Alloy 600 Aging Management Program in Section A.2.1.1. of the ANO-2 LRA:

> This program will manage aging effects of alloy 600/690 items and alloy 52/152 and 82/182 welds in the reactor coolant system that are not addressed by the Reactor Vessel Head Penetration Inspection Program, Section A.2.1.21, and the Steam Generator Integrity Program, Section A.2.1.26. This program will detect cracking from primary water stress corrosion cracking (PWSCC) by using the examination and inspection requirements specified in ASME Section XI. The Alloy 600 Aging Management Program will be initiated prior to the period of extended operation.

The applicant also provided the following revised FSAR Supplement summary description for the Alloy 600 Aging Management Program in Entergy Letter No. 2CAN090403, dated September 23, 2004:

A.2.1.1 Alloy 600 Aging Management Program

This program will manage aging effects of alloy 600/690 items and alloy 52/152 and 82/182 welds in the reactor coolant system that are not addressed by the Reactor Vessel Head Penetration Inspection Program, Section A.2.1.21, and the Steam Generator Integrity Program, Section A.2.1.26. This program will detect cracking from primary water stress corrosion cracking (PWSCC) by using the examination and inspection requirements specified of ASME Section XI, as augmented by commitments made in response to NRC correspondence. The Alloy 600 Aging Management Program will be initiated prior to the period of extended operation.

For the CLB for ANO-2, the applicant has proposed some augmentation of the ASME Section XI ISI requirements for ASME Code Class 1 Nickel-Alloy components. The staff has confirmed that the applicant has committed to implementing the augmented inspection requirements of NRC Order EA-03-009 and Revision 1 of the Order for inspections of the upper RV head and its penetration nozzles. For the period of extended operation, the applicant will implement these requirements and manage PWSCC in the ANO-2 upper RV head penetration nozzles through implementation of the Reactor Vessel Head Penetrations Program. These requirements and commitments are discussed and evaluated in Section B.1.20, *Reactor Vessel Head Penetration,* of this SER. The staff has also confirmed that the applicant is using its commitments that were made in response to NRC Bulletin 2004-01 as the basis for managing PWSCC in the ANO-2 pressurizer penetration nozzles. These commitments are identified in Entergy Letter No. 0CAN070404, *Response to NRC 2004-01 Regarding Inspection of Alloy 82/182/600 Materials Used in Pressurizer Penetrations and Steam Space Piping Components (July 27, 2004),* and include a commitment to perform bare-metal visual examinations of the Nickel-Alloy components in pressurizer penetrations during subsequent refueling outages, starting with refueling outage No. 17 in Spring 2005. These commitments comply with augmented inspection requirements of NRC Order EA-03-009 and conform to the staff's recommendations for augmented examinations of pressurizer penetration nozzles and steam space piping components, as recommended in NRC Bulletin 2004-01.

The staff has also confirmed that the applicant has committed to submit the inspection plan for the Alloy 600 Aging Management Program to the staff for review and approval at least 24 months prior to entering the period of extended operation for ANO-2 and has incorporated this commitment into the Commitment Tracking List for the ANO-2 LRA, as specified in Entergy Letter No. Letter No. 2CAN090402, dated September 10, 2004. Based on the FSAR Supplement Summary description for the Alloy 600 Aging Management Program and the applicant's commitments for augmented inspections of the upper RV head penetration nozzles and pressurizer penetration nozzles and for submittal of the inspection plan for the AMP, the staff concludes that the revised FSAR Supplement summary description for the Alloy 600 Aging Management Program is acceptable.

Conclusion

The staff has reviewed the Alloy 600 Aging Management Program, as discussed in Section B.1.1 of the ANO-2 LRA. On the basis of its review of the applicant's program including the applicant's commitment to request NRC staff review and approval of the Nickel-Alloy inspection program, the staff finds that the program adequately addresses the 10 program elements defined in Branch Technical Position (BTS) RLSB-1 in Appendix A.1 of the SRP-LR, and that

the program will adequately manage the aging effects for which it is credited so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the UFSAR Supplement summary description for this AMP, as described in Section A.2.1.1 of the ANO-2 LRA, and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.3.2 Bolting and Torquing Activities Program

Summary of Technical Information in the Application

The applicant described its Bolting and Torquing Activities Program in Section B.1.2 of Appendix B to the Application. It is a plant-specific program in ANO-2. The applicant stated that this program relies on recommendations for a comprehensive bolting integrity program, as delineated in the Electric Power Research Institute EPRI NP-5067, "Good Bolting Practices." This program also relies on industry recommendations for comprehensive bolting maintenance, as delineated in EPRI TR-104213, "Bolted Joint Maintenance & Applications Guide," for pressure retaining bolting. The applicant stated that a similar program based on EPRI NP-5067 and EPRI TR-104213 has previously been evaluated and approved by the NRC as documented in NUREG-1743, "Safety Evaluation Report Related to the License Renewal of Arkansas Nuclear One, Unit 1."

Staff Evaluation

The staff evaluation of the ANO-2 Bolting and Torquing Activities Program focused on how the program manages the aging effect through effective incorporation of the following ten attributes: program scope, preventive or mitigative actions, parameters monitored/inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience.

[Program Scope] The applicant stated that the program covers bolting in high temperature systems and in applications subject to significant vibration as determined during aging management review.

In RAI B.1.2-1, the staff requested that the applicant clarify whether the program covers all bolting within the scope of license renewal, greater than or smaller than 2-inch diameter, including safety-related bolting, bolting for NSSS component supports, bolting for other pressure retaining components, and structural bolting. The staff requested that the applicant provide assurance that the recommendations and guidelines for the plant-specific bolting program conform to industry's technical guidelines. By letter dated April 6, 2004, the applicant stated that the Bolting and Torquing Activities Program applies to closure bolting for components subject to aging management review in high temperature systems and in applications subject to significant vibration. Thus, it applies to safety-related bolting, nonsafety-related bolting, and bolting for pressure retaining components. It does not apply, however, to bolting for NSSS components supports and structural bolting. The programs managing aging effects of component supports and structural bolting are listed in the tables in LRA Section 3.5, Structures and Component Supports. In addition, the applicant stated that the program covers both larger than and smaller than or equal to 2-inch diameter bolting.

The applicant reiterated the statement in GALL XI.M18, Bolting Integrity, "The industry's technical basis for the program for safety-related bolting and guidelines for material selection and testing, bolting preload control, inservice inspection (ISI), plant operation and maintenance, and evaluation of structural integrity of bolted joints, are outlined in EPRI NP-5769, with the exceptions noted in NUREG 1339. For other bolting, this information is set forth in EPRI TR-104213." Also, EPRI NP-5769 states that EPRI NP-5067, Good Bolting Practices, satisfies the industry's need for guidance on assembly of bolted joints. In ANO-2 LRA, EPRI NP-5067 and EPRI TR-104213, Bolted Joint Maintenance & Application Guide are utilized as guidance in the Bolting and Torquing Activities Program. Based on the above, the staff considered that the guidelines utilized for the Bolting and Torquing Activities Program reflect industry practice. RAI B.1.2-1 is, therefore, closed.

[Preventive Actions] The applicant stated that preventive actions include proper selection of bolting material and the use of the appropriate lubricants and sealants in accordance with the guidelines of EPRI NP-5067. Initial inspection of bolting for pressure retaining components includes a check of the bolt torque and uniformity of the gasket compression after assembly. Hot torque checks are not applied to all bolted closures within the scope of this program, but are procedurally controlled if vendor-recommended or if determined necessary on a case-by-case basis. The staff considered the preventive actions taken by the applicant to be adequate in preventing the aging effect of loss of mechanical closure integrity, due to loss of preload or vibration, and are, therefore, acceptable.

[Parameters Monitored/Inspected] The applicant stated that torque values are monitored when the bolted closure is assembled. Maintenance personnel visually inspect components used in the bolted closures to assess their general condition during maintenance.

In RAI B.1.2-2, the staff requested the applicant to discuss the specifics of the conditions of the closure bolting to be inspected, and to explain why torque values are the only parameters to be monitored. The staff also requested the applicant to provide details of the methods of its visual inspection, and explain why inspection techniques other than visual inspection are not included in the program. By letter dated April 6, 2004, the applicant stated that under the Bolting and Torquing Activities Program, loss of mechanical closure integrity is managed by proper torquing during assembly of the bolted closure. The program is a preventive program rather than an inspection program to detect the effects of aging. Visual inspections to manage the effects of aging are not included in this program. Instead, as described in LRA Section B.1.2 under Parameters Monitored/Inspected, maintenance personnel visually inspect components used in the bolted closures to assess their general condition during maintenance. Prior to assembly, the mating surfaces and bolting components are inspected for manufacturing defects, galls, spurs, or dirt. After assembly, the closure is inspected for uniformity of gasket compression, proper thread engagement and proper locking tab installation. The applicant stated that torque values are the only parameters specified to be monitored because the aging effect being managed is loss of mechanical closure integrity due to loss of pre-load, not loss of material. If loss of material is an aging effect requiring management for the same bolted closures, it is managed by another program such as System Walkdown or Boric Acid Corrosion Prevention Program. The staff considered the applicant's response to be adequate in explaining how the mating surfaces and bolting components are inspected prior to and after assembly, and why torque values are the only parameters to be monitored. RAI B.1.2-2 is, therefore, closed

[Detection of Aging Effects] As stated earlier, the program is a preventive program, not an inspection program for detecting the effects of aging. Preventive actions under the program prevent loss of mechanical closure integrity.

There was no discussion in LRA as to what aging effects/mechanisms requiring management are included under the aging effect of loss of mechanical closure integrity. In RAI B.1.2-3, the staff requested that the applicant provide a detailed description of the aging effects which attribute to loss of mechanical closure integrity, and to discuss how the aging management program is expected to manage them. The staff also requested that the applicant ensure that, as delineated in GALL XI.M18, Bolting Integrity, the inspection requirements of the ASME Code, Section XI, are met. By letter dated April 6, 2004, the applicant stated that loss of mechanical closure integrity is the aging effect caused by loss of preload due to high temperature or vibration. If loss of material is an aging effect requiring management for the same bolted closures, it is managed by another program such as System Walkdown or Boric Acid Corrosion Prevention Program. The GALL program XI.M18, "Bolting Integrity," stipulates the inservice inspection requirements of the ASME Code, Section XI. These ISI requirements are included in the ANO-2 Inservice Inspection Program for Class 1, 2, and 3 bolted closures. However, these inspection requirements are focused on identifying the aging effect of cracking. Since cracking is not an aging effect requiring management for Non-Class 1 bolted closures, the applicant stated that the Inservice Inspection Program was not credited as an aging management program for the ASME Class 2 and 3 bolted closures. The applicant also stated that inspection requirements of ASME Code, Section XI, will continue to be met as required by 10CFR50.55a during the period of extended operation. The staff considered the applicant's response to be adequate in explaining the difference between the Bolting and Torquing Activities Program and the GALL XI.M18, Bolting Integrity, and in ensuring that inspection requirements of ASME Code, Section XI, will continue to be met. RAI B.1.2-3 is, therefore, closed.

[Monitoring and Trending] The applicant stated that torque values are monitored during the bolt torquing process. Trending is not applicable to this program. The ANO-2 Corrective Action Program applies. This provides assurance that trends entailing repeat failures to meet acceptance criteria will be identified and addressed with appropriate corrective actions.

In RAI B.1.2-4, the staff requested the applicant to discuss the details of the inspection schedule and its basis. By letter dated April 6, 2004, the applicant stated that under the Bolting and Torquing Activities Program, loss of mechanical closure integrity is managed by proper torquing during assembly of the bolted closure. The applicant stated that visual inspections to find evidence of aging effects are not performed under this program, thus there is no frequency to be provided. The staff considered the applicant's response to be adequate in explaining why there is no inspection frequency involved in the Bolting and Torquing Activities Program, as versus to the Inservice Inspection Program included in GALL XI.M18, Bolting Integrity. RAI B.1.2-4 is, therefore, closed.

[Acceptance Criteria] The applicant stated that acceptance criteria are provided in site procedures. Typical criteria are that mating surfaces are smooth and free of major defects. Other criteria include proper and adequate thread engagement and use of appropriate torque values.

To ensure that mating surfaces perform their intended function as a pressure retaining boundary, the staff requested in RAI B.1.2-5 that the applicant enhance the criteria by requiring that the surfaces be thoroughly inspected, for potential aging effects, such as corrosion, cracking, and/or leaking. This includes identification of all relevant indications and signs of degradation at the surfaces. By letter dated April 6, 2004, the applicant stated that under the Bolting and Torquing Activities Program, loss of mechanical closure integrity is managed by proper torquing during assembly of the bolted closure. As discussed in its response to RAI B.1.2-2, the applicant stated that the inspection of mating surfaces under this program is an inspection for manufacturing defects, galls, spurs, or dirt prior to assembly of the bolted closure. Management of aging of component mating surfaces to ensure that they perform their intended function as a pressure retaining boundary is performed by the program which manages aging of the component itself. The staff considered the applicant's response to be adequate in defining the acceptance criteria of the program, which is the smoothness of the mating surfaces and the proper torque values. RAI B.1.2-5 is, therefore, closed.

[Operating Experience] The applicant stated that the ANO-2 Bolting and Torquing Activities Program is the same program credited for ANO-1 license renewal. ANO bolting and torquing practices were evaluated during NRC review of the ANO-1 LRA. On the basis of the review, the NRC staff found that the Bolting and Torquing Activities Program, which is part of the CLB, will continue to be adequate to assure that threaded joints will perform their intended functions during the period of extended operation.

The applicant stated that repetitive occurrences of deficient bolting and torquing activities are identified by the ANO staff. Corrective actions are established to address deficient conditions regarding torquing of mechanical fasteners and to preclude their recurrence. The applicant stated that this operating experience demonstrates that the Bolting and Torquing Activities Program will provide assurance that the aging effects associated with bolted closures will be managed such that applicable structures and components will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation. In RAI B.1.2-6, the staff requested that the applicant elaborate on the types of repetitive occurrences of deficient bolting and torquing activities, and how the deficiencies were dispositioned. By letter dated April 6, 2004, the applicant stated that in 1998 the ANO staff identified repetitive occurrences of improper torquing requirements resulting from inadequate personnel work practices, evidenced by leaking connections. Corrective actions, such as procedure changes and training were taken to address the deficient conditions and to preclude their recurrence. The applicant stated that independent verification of proper torque values was also added to work instructions. Subsequent trending data revealed the corrective actions were effective in precluding the identified conditions. The staff considered the applicant has adequately identified the cause of the earlier deficient bolting and torquing practice, and has properly implemented the corrective actions. RAI B.1.2-6 is, therefore, closed.

The staff considered the applicant's operating experience to be an asset to the Bolting and Torquing Activities Program in managing the loss of mechanical closure integrity. This operating experience will help minimize recurrence of deficient conditions of closure bolting, and thus provide assurance that the aging effects associated with bolted closures will be managed such that applicable structures and components will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

UFSAR Supplement

The Bolting and Torquing Activities Program manages the loss of mechanical closure integrity for bolted connections and bolted closures in high temperature systems and in applications subject to significant vibration. The program relies on recommendations for a comprehensive bolting integrity program, as delineated in the Electric Power Research Institute EPRI NP-5067, Good Bolting Practices. The program also relies on industry recommendations for comprehensive bolting maintenance, as delineated in the EPRI TR-104213, Bolted Joint Maintenance & Applications Guide.

Conclusion

Based on the information provided by the applicant, the staff finds that the Bolting and Torquing Activities Program is adequate for managing the loss of mechanical closure integrity for bolted connections and bolted closures in high temperature systems and in applications subject to significant vibration. On the basis of its review, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the UFSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.3.3 Heat Exchanger Monitoring Program

Summary of Technical Information in the Application

The applicant's heat exchanger monitoring program is described in LRA Section B.1.12, "Heat Exchanger Monitoring." In the LRA, the applicant stated that the program is plant-specific and will be initiated prior to the period of extended operation. This AMP is credited with inspecting heat exchangers to detect degradation and, if warranted, evaluating the effects of the degradation on the design functions, including seismic operability.

Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in Appendix B, Section B.1.12, of the LRA, regarding the applicant's demonstration of the heat exchanger monitoring program to ensure that the effects of aging, as discussed above, will be adequately managed so that the intended functions will be maintained consistent with the CLB throughout the period of extended operation.

The staff reviewed the heat exchanger monitoring program against the AMP elements found in the SRP-LR, Appendix A, Section A.1.2.3, and SRP-LR Table A.1-1 and focused on how the program manages aging effects through the effective incorporation of 10 elements (i.e., program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience.)

The applicant indicated that the corrective actions, confirmation process, and administrative

controls are part of the site-controlled quality assurance program. The staff's evaluation of the quality assurance program is provided separately in Section 3.0.4 of this SER. The remaining seven elements are discussed below.

[Scope of the Program] The applicant stated that this program element encompasses managing aging effects on selected heat exchangers as identified in Section 3 of the LRA. The staff reviewed Section 3 of the LRA and determined that the heat exchanger monitoring program is credited with managing aging effects for specific heat exchanger components in the containment spray and emergency diesel generator systems. The staff confirmed that the specific components for which the heat exchanger monitoring program manages aging effect are identified, which satisfies the criterion defined in Appendix A.1 of the SRP-LR. On this basis, the staff finds that the applicant's proposed scope is acceptable.

[Preventive Maintenance] The applicant stated that this is an inspection program and no actions are taken as part of this program to prevent degradation. The staff finds that the heat exchanger monitoring program is a condition monitoring program. It provides early indication and detection of the onset of aging degradation. It does not rely on preventive actions. Therefore, staff finds this acceptable.

[Parameters Monitored or Inspected] The applicant stated that non-destructive examinations will be performed. Eddy current testing will be used to identify wall thinning and cracking in shell-and-tube heat exchangers. Heat exchanger heads, covers, and tube sheets will be inspected using visual inspection methods.

The staff noted that although traditional eddy current testing methods can be applied to most heat exchangers, the shutdown heat exchanger contains ferritic stainless steel tubes. Traditional eddy current testing methods cannot be used in this application. The applicant plans to use a testing method similar to eddy current testing that will detect wall thinning and cracking in these tubes. During the audit, the staff requested details on this inspection methodology from the applicant. By letter dated January 22, 2004, the applicant provided details on this methodology. Specifically, the applicant identified a modified version of eddy current testing method called remote field testing as the selected technique, and stated that other appropriate examination techniques may be available at the time of program implementation and will be based on industry operating experience.

The staff reviewed the applicant's response, and finds that the inspection technique is sufficient to provide assurance that the aging effects for the components addressed by the heat exchangers monitoring program will be detected before loss of intended function.

The staff confirmed that this program element satisfies the criteria defined in Appendix A of the SRP-LR. The heat exchanger monitoring program is acceptable because the non-destructive examinations of the heat exchangers are intended to detect the presence and extent of aging effects. On this basis, the staff finds that the parameters monitored or inspected is acceptable.

[Detection of Aging Effects] The applicant stated, in Appendix B, Section B.1.12 of the LRA, that

- The aging effects being managed by this program for the tubes are loss of material and cracking. An appropriate sample population of heat exchangers will be determined

based on operating experience prior to the inspections. The extent and schedule of the inspections prescribed by the program are designed to maintain seismic qualification and ensure that aging effects will be discovered and repaired before the loss of intended function.

- The eddy current inspection of the tubes will be every 10 years, or more frequently if inspection results indicate a need for more frequent inspections. The visual inspections of the accessible heat exchangers will be performed on the same frequency as the eddy current inspections.
- Inspection can reveal cracking and loss of material that could result in degradation in the seismic qualification of the heat exchangers. Fouling is not addressed by this program.

The staff noted that, although traditional eddy current testing methods can be applied to most heat exchanges, the shutdown heat exchanger contains ferritic stainless steel tubes. Traditional eddy current testing methods cannot be used in this application. The applicant has developed a testing method, similar to eddy current testing, that will be used to detect wall thinning and cracking in these tubes. During the audit, the staff requested details on this inspection methodology from the applicant. By letter dated January 22, 2004, the applicant provided details on this methodology. Specifically, the applicant identified a modified version of eddy current testing method called remote field testing as the selected technique, and stated that other appropriate examination techniques may be available at the time of program implementation and will be based on industry operating experience. The staff reviewed the applicant's response, and finds that the inspection technique is acceptable (see discussion above).

The staff confirmed that this program element satisfies the criteria defined in Appendix A.1 of the SRP-LR. Testing techniques will be developed, based on industry operating experience; sample population of heat exchangers will be determined based on operating experience prior to the inspections; and eddy current inspection of the tubes will be every 10 years, or more frequently if inspection results indicate a need for more frequent inspections. On this basis, the staff concludes that the detection of aging effects is acceptable.

[Monitoring and Trending] The applicant stated, in Appendix B, Section B.1.12, of the LRA, that the wall thickness of heat exchanger tubing and the material condition of heat exchanger heads, covers, and tube sheets will be trended. Results will be evaluated against established acceptance criteria and an assessment will be made regarding the applicable degradation mechanism, degradation growth rate, and the allowable degradation level. This information will be used to develop future inspection scope and inspection frequency.

The staff confirmed that this program element satisfies the criteria defined in Appendix A.1 of the SRP-LR. Trending of inspection results will be performed and will enhance the applicant's ability to detect aging effects before there is a loss of intended function. On this basis, the staff finds that the monitoring and trending is acceptable.

[Acceptance Criteria] The applicant stated, in Appendix B, Section B.1.12, of the LRA, that

- The tube plugging limit for each heat exchanger to be eddy-current inspected will be established based upon a component-specific engineering evaluation. This evaluation will determine conservative acceptance criteria that will identify when degraded tubes must be removed from service.

- The acceptance criterion for visual inspections of heat exchanger heads, covers, and tube sheets will be no evidence of degradation that could lead to loss of function. If degradation that could lead to loss of intended function is detected, a condition report will be written and the issue resolved in accordance with the site corrective action program.

During the audit, the staff requested that the applicant provide specific and detailed acceptance criteria and its basis for the heat exchanger monitoring program. By letter dated January 22, 2004, the applicant provided the heat exchanger monitoring program specific acceptance criterion. In its response, the applicant identified that the acceptance criterion for the tube eddy-current inspections will be wall loss less than 60 percent through wall, which follows the industry practice that considers this a conservative standard for requiring evaluation of the need for potential corrective action. In its response, the applicant also stated that the acceptance criterion for eddy current testing of heat exchanger tubes is conservatively based on a combination of ASME code requirements and industry practice. The staff reviewed the applicant's response, and finds it to be acceptable.

The staff confirmed that this program element satisfies the criteria defined in Appendix A.1 of the SRP-LR. Any degradation that could lead to loss of function will be found unacceptable and corrective measures implemented. On this basis, the staff finds that the acceptance criteria is acceptable.

[Operating Experience] The applicant stated, in Appendix B, Section B.1.12, of the LRA, that the heat exchanger monitoring program is a new program for which there is no operating experience. The elements that constitute this program are consistent with years of industry practice. The applicant stated that the program will be administered under the site quality assurance (QA) program, which is subject to the requirements of 10 CFR 50, Appendix B.

During the audit, the staff asked the applicant to clarify and/or provide the operating experience reviews for new programs. In its response, the applicant stated that the plant corrective action program, which captures internal and external plant operating experience issues, provides assurance that operating experience will be reviewed and incorporated in the future to provide objective evidence to support the conclusion that the effects of aging will be adequately managed.

On the basis of its review of the applicant's response and on discussions with the applicant's technical staff, the staff concludes that the heat exchanger monitoring program will adequately manage the aging effects that have been observed at the applicant's plant.

UFSAR Supplement

In Appendix A, Section A.2.1.13, of the LRA, the applicant provided the UFSAR supplement for the heat exchanger monitoring program and stated that the program will manage loss of material and cracking, as applicable, on heat exchangers in various systems. The program will inspect heat exchangers for degradation using non-destructive examinations, such as eddy-current inspections and visual inspections. If degradation is found, then an evaluation will be performed to determine its effects on the heat exchanger's design functions. The applicant stated in Appendix A that the heat exchanger monitoring program will be initiated prior to the period of extended operation. The staff reviewed this section and determined that the

information in the UFSAR supplement provides an adequate summary of the program activities, as identified in the SRP-LR UFSAR supplement table and as required by 10 CFR 54.21(d).

Conclusion

On the basis of its review and audit of the applicant's program, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the UFSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.3.4 Inservice Inspection – Containment Inservice Inspection

Summary of Technical Information in the Application

The applicant's inservice inspection – containment inservice inspection program is described in LRA Section B.1.13, "Inservice Inspection – Containment Inservice Inspection." In the LRA, the applicant stated that the program is plant-specific. The applicant also stated that the program implements the applicable requirements of the ASME Boiler and Pressure Vessel Code, Section XI, Subsections IWE and IWL, as modified by 10 CFR 50.55a. Every 10 years the program is updated to the latest ASME Section XI code edition and addendum approved by the NRC in 10 CFR 50.55a. The applicant credits the program, under ASME Section XI, Subsection IWE, with managing loss of material for the steel containment liner and its integral attachments. The applicant credited the program, under ASME Section XI, Subsection IWL, with confirming that the effects of aging on the reinforced concrete containment shell and post-tensioning systems will not prevent the performance of intended functions consistent with the CLB for the period of extended operation.

Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in Appendix B, Section B.1.13, of the LRA, regarding the applicant's demonstration of the inservice inspection – containment inservice inspection program to ensure that the effects of aging, as discussed above, will be adequately managed so that the intended functions will be maintained consistent with the CLB throughout the period of extended operation.

The staff reviewed the inservice inspection – containment inservice inspection program against the AMP elements found in the SRP-LR, Appendix A, Section A.1.2.3, and SRP-LR Table A.1-1 and focused on how the program manages aging effects through the effective incorporation of 10 elements (i.e., program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience.)

The applicant indicated that the corrective actions, confirmation process, and administrative controls are part of the site-controlled quality assurance program. The staff's evaluation of the quality assurance program is provided separately in Section 3.0.4 of this SER. The remaining seven elements are discussed below.

[Scope of Program] The applicant stated that the inservice inspection - containment inservice inspection program, under ASME Section XI, Subsection IWE, manages loss of material for the steel containment liner and its integral attachments. This is within the scope of Subsection IWE-1000. Under ASME Section XI, Subsection IWL, the program manages the effects of aging on the reinforced concrete containment shell and post-tensioning systems to ensure that they will perform in accordance with the CLB. This is within the scope of Subsection IWE-1000.

The staff confirmed that the specific components for which the inservice inspection - containment inservice inspection program are identified. The program scope program element satisfies the criterion defined in Appendix A.1 of the SRP-LR. On this basis, staff finds that the applicant's proposed scope is acceptable.

[Preventive Action] The applicant stated that this is a monitoring program that does not include preventive actions. The staff confirmed that the preventive actions program element satisfies the criterion defined in Appendix A.1 of the SRP-LR. The staff did not identify the need for preventive actions for AMP B.1.13 because it is a condition monitoring program.

[Parameters Monitored/Inspected] The applicant stated, in Appendix B, Section B.1.13, of the LRA, that visual inspections for Subsection IWE monitor for corrosion and loss of material of the steel containment liner and its attachments by inspecting the surface for evidence of flaking, blistering, peeling, discoloration, and other signs of distress. For Subsection IWL, prestressing force is measured by lift-off testing or equivalent test which is a TLAA. The staff's review of the applicant's evaluation of this TLAA is documented in Section 4.5 of this SER. In performing this review, the staff followed the guidance in Section 4.5 of the SRP-LR.

In addition, the applicant stated that tendon surveillance testing consists of inspection of the sheathing filler material and anchorage, tendon wire continuity testing, and tendon wire inspection.

The staff confirmed that this program element satisfies the criteria defined in Appendix A.1 of the SRP-LR. The visual inspections (Subsection IWE) and prestressing force measurements (Subsection IWL) are intended to detect the presence and extent of aging effects. On this basis, the staff finds that the parameters monitored or inspected is acceptable.

[Detection of Aging Effects] The applicant stated that the aging effect being managed under ASME Section XI, Subsection IWE, is loss of material for the steel containment liner and its integral attachments. Under ASME Section XI, Subsection IWL, the program manages the effects of aging on the reinforced concrete containment shell and post-tensioning system. The primary inspection method for the steel containment liner and its integral attachments is visual examination (general visual, VT-3, VT-1). Limited volumetric examination (ultrasonic thickness measurement) and surface examination (e.g., liquid penetrant) may be necessary in some instances. The primary inspection method for the concrete containment shell is visual examination (general, VT-1). The tendon prestressing force is measured by lift-off or equivalent test. Tendon surveillance testing consists of the sheathing filler material and anchorage inspection, tendon lift-off force measurement, tendon wire continuity testing, tendon wire inspection, and tensile testing. The tendon surveillance is performed periodically on a randomly selected group of tendons to provide confidence in the functional capability of the system.

The GALL Report Volume 2, Item IIA.3-1d recommends that examination categories E-B and E-F and additional examinations be performed during the period of extended operation to detect stress corrosion cracking (SCC) of stainless steel and dissimilar metal welds' containment penetration bellows assemblies. This recommendation is addressed in LRA Table 3.5.1, Item Number 3.5.1-2. During the audit, the staff noted that these examination categories were not committed to.

In pursuing this issue, the staff noted that in response to a separate staff RAI 3.5-1, by letter dated May 19, 2004, the applicant stated that no bellows are used for piping system containment penetrations. The fuel transfer tube is equipped with bellows type expansion joints that connect the transfer tube to the liner of the refueling canal in containment and to the liner of the spent fuel pool in the auxiliary building. The applicant stated that Table 3.5.1, Item Number 3.5.1-2 of Table 3.5.1 applies to the fuel transfer tube sleeve but not to the bellows since the bellows is not part of the containment penetration boundary. The bellows connecting the transfer tube to the refueling canal liner is an extension of the refueling canal liner which has no license renewal intended function. The bellows on the other end of the transfer tube connects the transfer tube to the liner in the fuel tilt pit portion of the spent fuel pool. The low point of the opening connecting the spent fuel pool to the tilt pit is above the top of the spent fuel stored in the storage racks so failure of the bellows cannot result in uncovering of the fuel. Therefore, neither bellows attached to the fuel transfer tube performs a license renewal intended function.

On the basis of its review and of the applicant's response to RAI 3.5-1, the staff confirmed that this program element satisfies the criteria defined in Appendix A.1 of the SRP-LR. The staff acknowledges that the frequency and scope of examination specified in 10 CFR 50.55a and ASME Section XI, Subsections IWE and IWL, ensure that aging effects will be detected before they compromise the design basis requirements. The inspections use a frequency and sample size based on existing codes and operating experience to detect the presence and extent of aging effects. On this basis, the staff concludes that the parameters monitored or inspected is acceptable.

[Monitoring and Trending] The applicant stated, in Appendix B, Section B.1.13, of the LRA, that that the responsible engineer periodically trends the measured prestressing forces from surveillances. If this review indicates a trend that would result in the tendon forces for a tendon or a group of tendons to be less than the minimum prestress value before the next inspection period, the responsible engineer (or designee) prepares a condition report.

The staff determined that with the exception of inaccessible areas, all metal and concrete surfaces within the scope are monitored by examination requirements of Subsections IWE and IWL. Periodically measured tendon prestressing forces are monitored in accordance with the requirements specified in Subsection IWL and trended to ensure that they remain above the minimum required level. The staff confirmed that this program element satisfies the criteria defined in Appendix A.1 of the SRP-LR. Trending of the surveillance results will enhance the applicant's ability to detect aging effects before there is a loss of intended function. On this basis, the staff finds that the monitoring and trending is acceptable.

[Acceptance Criteria] The applicant stated, in Appendix B, Section B.1.13, of the LRA, that the numerical acceptance standards provided in IWE-3000 for wall thickness and the numerical values provided in IWL-3000 for post-tensioning systems are utilized. No other numerical

acceptance standards are provided for the steel containment liner and its integral attachments or for the reinforced concrete containment. The expertise and engineering judgment of the responsible engineer are relied upon to detect conditions that could affect the leak-tightness or structural integrity of the containment or prevent an inspected component from performing its intended function.

The staff confirmed that this program element satisfies the criteria defined in Appendix A.1 of the SRP-LR. Any wall thickness post-tensioning system values that are projected to fall below the minimum allowable, as determined by the applicable design code, will be found unacceptable and corrective measures implemented. On this basis, the staff finds that the acceptance criteria is acceptable.

[Operating Experience] The staff reviewed the applicant's engineering report related to the operating experience for this program. Condition report trending data for the period 1998 through 2002 did not identify a need for improvements to this program. The applicant also stated that the plant corrective action program, which captures internal and external plant operating experience issues, provides assurance that operating experience will be reviewed in the future to provide objective evidence to support the conclusion that the effects of aging will be adequately managed.

The staff agrees that even though limited operating experience was available, the inservice inspection – containment inservice inspection programs provided assurance that the applicable aging effects would be adequately managed for the period of extended operation.

UFSAR Supplement

In Appendix A, Section A.2.1.14, of the LRA, the applicant provided the UFSAR supplement for the inservice inspection – containment inservice inspection program and stated that the program implements the applicable requirements of ASME Section XI, Subsections IWE and IWL as modified by 10 CFR 50.55a. Every 10 years the containment inservice inspection program for ANO-2 is updated to the latest ASME Section XI code edition and addendum approved by the NRC in 10 CFR 50. The staff reviewed this section and determined that the information in the UFSAR supplement provides an adequate summary of the program activities, as identified in the SRP-LR UFSAR supplement table and as required by 10 CFR 54.21(d).

Conclusion

On the basis of its review and audit of the applicant's program, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.3.5 Inservice Inspection – Inservice Inspection

Summary of Technical Information in the Application

The applicant's inservice inspection – inservice inspection program is described in LRA Section B.1.14, "Inservice Inspection – Inservice Inspection" The applicant stated that this is a plant-specific program. The applicant credited this program with managing cracking, wear, loss of mechanical closure integrity, and loss of material of RCS piping and components, including RCP items and austenitic stainless steel small bore piping. This program implements the applicable requirements of the ASME Boiler and Pressure Vessel Code, Section XI, Subsections IWB, IWC, IWD, and IWF. In March 2000, ANO-2 entered the third ISI interval and began implementing the applicable requirements of the 1992 Edition of ASME Section XI, with pressure-testing criteria from the 1993 Addenda, approved NRC alternatives and relief requests, and other requirements specified in 10 CFR 50.55a.

Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in Appendix B, Section B.1.14, of the LRA, regarding the applicant's demonstration of the inservice inspection – inservice inspection program to ensure that the effects of aging, as discussed above, will be adequately managed so that the intended functions will be maintained consistent with the CLB throughout the period of extended operation.

The staff reviewed the inservice inspection – inservice inspection program against the AMP elements found in the SRP-LR, Appendix A, Section A.1.2.3, and SRP-LR Table A.1-1 and focused on how the program manages aging effects through the effective incorporation of 10 elements (i.e., program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience.)

The applicant indicated that the corrective actions, confirmation process, and administrative controls are part of the site-controlled quality assurance program. The staff's evaluation of the quality assurance program is provided separately in Section 3.0.4 of this SER. The remaining seven elements are discussed below.

[Program Scope] The applicant stated, in Appendix B, Section B.1.14, of the LRA, that the inservice inspection program manages cracking, wear, loss of mechanical closure integrity, and loss of material of RCS piping and components, including RCP items and austenitic stainless steel small bore piping. The inservice inspection program is updated as required to the latest ASME Section XI code edition and addendum approved by the NRC in 10 CFR 50.55a. A risk-informed methodology is used to select Class 1, 2, and 3 piping welds for inspection in lieu of the requirements specified in the 1992 Edition of the ASME Section XI.

The staff reviewed the risk-informed inservice inspection (RI-ISI) methodology to determine if this approach is applicable to the period of extended operation. The applicant stated that there are no time-dependent parameters used that would change the determination of risk for a component as a result of operating during the license renewal period. The applicant also stated that any new degradation mechanism or change in consequence of piping failures that occurs

over the license of the plant, including the period of extended operation, is incorporated into the RI-ISI program.

In order to evaluate the applicant's position, the staff reviewed the technical bases of the RI-ISI program and determined that the program scope is capable of managing the identified aging mechanisms. The applicant demonstrated that the aging effects identified for Class 1 piping are managed by the RI-ISI program. This was accomplished by identifying all the Class 1 piping aging effects that credit the RI-ISI program for aging management. These aging effects were compared with the aging effects identified in one of the RI-ISI program bases documents (EPRI TR-106706). All credited aging effects were found to be included in the program. The applicant also clarified that although the RI-ISI program addresses Class 1, 2, and 3, only the Class 1 portion of the risk-informed program is included in the LRA.

The staff confirmed that the program scope program element satisfies the criterion defined in Appendix A.1 of the SRP-LR. The proposed scope identifies the specific components for which the program manages aging. On this basis, the staff finds that the applicant's proposed program scope is acceptable.

[Preventive Action] The applicant stated that this program element is not applicable because the inservice inspection - inservice inspection program is an inspection program.

The staff confirmed that the preventive actions program element satisfies the criterion defined in Appendix A.1 of the SRP-LR. The staff did not identify the need for preventive actions for this program because it is a condition monitoring program.

[Parameters Monitored/Inspected] The applicant stated, in Appendix B, Section B.1.14, of the LRA, that the program uses non-destructive examination techniques to detect and characterize flaws. The three different types of examinations are volumetric, surface, and visual. Volumetric examinations are the most extensive, using methods such as radiographic, ultrasonic, or eddy current examinations to locate surface and subsurface flaws. Surface examinations, such as magnetic particle or dye penetrant testing, are used to locate surface flaws.

Three levels of visual examinations are specified. The VT-1 visual examination is conducted to assess the condition of the surface of the part being examined, looking for cracks and symptoms of wear, corrosion, erosion, or physical damage. It can be done with either direct visual observation or with remote examination using various optical/video devices. The VT-2 examination is conducted specifically to locate evidence of leakage from pressure-retaining components (period pressure tests). While the system is under pressure for a leakage test, visual examinations are conducted to detect direct or indirect indication of leakage. The VT-3 examination is conducted to determine the general mechanical and structural condition of components and supports and to detect discontinuities and imperfections.

The staff confirmed that this program element satisfies the criteria defined in Appendix A.1 of the SRP-LR. Measurements of wall thickness are intended to detect the presence and extent of aging effects. On this basis, the staff finds that the parameters monitored or inspected are acceptable.

[Detection of Aging Effects] The applicant stated that:

(1) The aging effects being managed by this program are cracking, wear, loss of mechanical closure integrity, and loss of material of RCS piping, valves and RCP items including bolting, valve bolting, and flange bolted connections. ASME Section XI, Subsection IWB, examination categories manage the aging effects of the Class 1 piping, valves, and RCP items. This program manages the aging effects through a combination of visual, surface, and volumetric examinations. Pressure boundary items undergo a system leakage test including a visual examination (VT-2) in accordance with ASME Section XI requirements.

(2) This program manages cracking of austenitic stainless steel small bore piping. The applicant defined small bore piping and small bore nozzles as those less than four-inch nominal pipe size that do not normally receive volumetric inspection in accordance with ASME Section XI. This program includes inspection of selected RCS piping welds. The inspection of RCS piping appropriately addresses cracking of piping greater than one-inch nominal pipe size for the period of extended operation.

(3) Cracking of the RCP covers is managed by visual examinations conducted in accordance with ASME Section XI examination Category B-L-2. Volumetric inspections of the pump casing welds are no longer performed at ANO-2 due to implementation of code case –481. Visual examination of pressure-retaining surfaces is performed in accordance with ASME Section XI requirements.

(4) This program manages cracking of the shell, lower heads and nozzles, and manway bolting, and supplements the boric acid corrosion prevention program in managing loss of material at external surfaces of the pressurizer. ASME Section XI, Subsection IWB, examination categories manage cracking and loss of material of the pressurizer pressure boundary and support items. This program manages cracking through a combination of visual, surface, and volumetric examinations.

(5) This program manages cracking of the reactor vessel, lower head, closure head, nozzles, and reactor vessel bolting, and supplements the boric acid corrosion prevention program in detecting loss of material at external surfaces of the reactor vessel and control element drive mechanism pressure boundary. ASME Section XI, Subsection IWB, examination categories manage cracking and loss of material of the reactor vessel and control element drive mechanism pressure boundary and support items. In addition to managing cracking, this program detects degradation as a result of wear. Closure studs, washers, nuts, and threaded holes of the vessel closure flange are visually inspected for wear in accordance with ASME Section XI requirements.

(6) Under ASME Section XI, Subsection IWB, the program manages cracking, wear, loss of preload, and loss of material of the reactor vessel internals items through visual examinations. Interior attachments and core support structures associated with the reactor vessel internals undergo a (VT-3) visual examination at the weld (for the attachments) and at the surface (for the core support structures).

(7) Under ASME Section XI, Subsections IWB, IWC, and IWD, the program manages cracking, wear, and loss of material of the steam generator pressure boundary and support items through a combination of visual, surface, and volumetric examinations.

(8) Under ASME Section XI, Subsection IWF, the program manages loss of material for ASME Class 1, 2, and 3 steel piping supports and steel component supports within the containment. The program also manages loss of material for steel base plates, component supports, and threaded fasteners, and cracking for threaded fasteners for ASME Class 1, 2, and 3 steel piping supports and steel component supports.

The staff confirmed that this program element satisfies the criteria defined in Appendix A.1 of the SRP-LR. The inspections use a frequency and sample size based on existing codes and operating experience to detect the presence and extent of aging effects. On that basis, the staff finds the program is capable of detecting aging effects.

[Monitoring and Trending] The applicant stated that this program does not require monitoring or trending of progressive, time-dependent degradation. Flaws detected are evaluated by comparing the examination results to the acceptance standards in ASME Section XI. Flaw indications require detailed analyses, repair, or replacement. The ISI results are recorded and provided to the NRC in accordance with ASME Section XI requirements. Reports describe the scope of the inspection and significant inspection results.

The staff agreed that the frequency of inspection and the inspection method are specified by the Code. Indications found by nondestructive examinations are evaluated in accordance with the Code and, if allowed to remain, will require monitoring and will be used for comparison with future inservice examination results. This provides for trending of the aging effect and establishes a baseline for the degradation process and the extent of degradation with time. The staff accepts this methodology to undertake further programmatic actions, such as repair and replacement, as necessary, to manage these aging effects.

The staff also confirms that this program element satisfies the criteria defined in Appendix A.1 of the SRP-LR. Trending of the inspection results enhances the applicant's ability to detect aging effects before there is a loss of intended function. On this basis, the staff finds that the monitoring and trending is acceptable.

[Acceptance Criteria] The applicant stated in Appendix B, Section B.1.14, of the LRA, that if a flaw is discovered during the performance of an ISI examination, an evaluation is conducted in accordance with article IWA-3000, IWB-3000, IWC-3000, IWD-3000, or IWF-3000.

The staff confirmed that this program element satisfies the criteria defined in Appendix A.1 of the SRP-LR. The staff reviewed the applicant's acceptance criteria and finds that any flaws discovered in the process of performing the inspections are deemed unacceptable and corrective measures are implemented. On this basis, the staff finds that the acceptance criteria is acceptable.

[Operating Experience] The applicant stated, in Appendix B, Section B.1.14, of the LRA, that condition report trending data does not identify a need for improvements to this program. A 2002 self assessment evaluated the inservice inspection programs using the NRC Inspections

Guideline 71111.08, "Inservice Inspection Activities." Minor deficiencies were noted and resolved during the evaluation.

The applicant also stated that the plant corrective action program, which captures internal and external plant operating experience issues, provides assurance that operating experience will be reviewed in the future to provide objective evidence to support the conclusion that the effects of aging will be adequately managed.

On the basis of its review of the above operating experience on the discussions with the applicant's technical staff, the staff finds that the inservice inspection – inservice inspection program adequately manages the aging effects that have been observed at the applicant's plant and can do so during the period of extended operation.

UFSAR Supplement

In Appendix A, Section A.2.1.15, of the LRA, the applicant provided the UFSAR supplement for the inservice inspection program and stated that the program implements the applicable requirements of ASME Section XI, Subsections IWB, IWC, IWD and IWF, and other requirements specified in 10 CFR 50.55a with approved NRC alternatives and relief requests. Every 10 years the inservice inspection program for ANO-2 is updated to the latest ASME Section XI code edition and addendum approved by the NRC in 10 CFR 50. The staff reviewed this section and determined that the information in the UFSAR supplement provides an adequate summary of the program activities, as identified in the SRP-LR UFSAR supplement table and as required by 10 CFR 54.21(d).

Conclusion

On the basis of its review and audit of the applicant's program, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.3.6 Oil Analysis

Summary of Technical Information in the Application

The applicant's oil analysis program is described in Section B.1.17, "Oil Analysis," of the LRA. In the LRA, the applicant stated that the program is plant-specific. This AMP is credited with ensuring the oil environment in the mechanical systems is maintained to the required quality.

Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in LRA Appendix B, Section B.1.17, of the LRA regarding the applicant's demonstration of the oil analysis program to ensure that the effects of aging, as discussed above, will be adequately managed so that the intended functions will be maintained consistent with the CLB throughout the period of extended operation.

The staff reviewed the oil analysis program against the AMP elements found in the SRP-LR, Appendix A, Section A.1.2.3, and SRP-LR Table A.1-1 and focused on how the program manages aging effects through the effective incorporation of 10 elements (i.e., program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience.)

The applicant indicated that the corrective actions, confirmation process, and administrative controls are part of the site-controlled quality assurance program. The staff's evaluation of the quality assurance program is provided separately in Section 3.0.4 of this SER. The remaining seven elements are discussed below.

[Scope of Program] The applicant stated, in Appendix B, Section B.1.17, of the LRA, that the oil analysis program encompasses periodic sampling of the lubricating oil to which plant components subject to an AMR are exposed. The purpose of the program is to ensure the oil environment in the mechanical systems is maintained to the required quality.

The staff also confirmed that the specific components for which the oil analysis program manages aging are identified and that this program element satisfies the criteria defined in Appendix A.1 of the SRP-LR. On this basis, the staff finds that the applicant's proposed scope is acceptable.

[Preventive Actions] The applicant stated that the oil analysis program maintains oil systems free of contaminants (primarily water and particulates) thereby preserving an environment that is not conducive to aging mechanisms.

The staff confirmed that the preventive actions program element satisfies the criterion defined in Appendix A.1 of the SRP-LR. The staff finds that the preventive actions program element is acceptable because maintenance of contaminant-free oil systems prevents and mitigates the identified aging effects.

[Parameters Monitored/Inspected] The applicant stated that for components with periodic oil changes in accordance with manufacturer's recommendations, a particle count and check for water are performed to detect evidence of abnormal wear rates, contamination by moisture, or excessive corrosion. For components that do not have regular oil changes, viscosity and neutralization number are also determined to evaluate the oil is suitable for continued use.

The staff reviewed the applicant's program, procedures, and database of lube oil sample results. The staff confirmed that this program element satisfies the criteria defined in Appendix A.1 of the SRP-LR. The oil sampling program activities detect the conditions that potentiate degradation and also detect the presence and extent of aging effects. On this basis, the staff finds that the parameters monitored or inspected program element is acceptable.

[Detection of Aging Effects] The applicant stated, in Appendix B, Section B.1.17, of the LRA, that periodic sampling and compliance with the acceptance criteria provide assurance that lube oil contaminants do not exceed acceptable levels. This manages the aging effects of cracking, loss of material, and fouling.

The staff confirmed that this program element satisfies the criteria defined in Appendix A.1 of the SRP-LR. (Sampling from a population is not applicable to this AMP.) Sampling is appropriately described and linked to the aging effects and compliance with the acceptance criteria allow for the timely detection of their presence and extent. Appropriate industry standards such as SAE749D, ISO 4406, ISO 112218, and NAS 1638 are used in the development of sampling methods and frequencies. On this basis, the staff finds that the detection of aging effects is acceptable.

[Monitoring and Trending] The applicant stated that oil analysis results are reviewed to determine if alert levels or limits have been reached or exceeded. This review also checks for unusual trends. The staff examined the procedures and tools used for this purpose and considers them to be effective.

The staff confirmed that this program element satisfies the criteria defined in Appendix A.1 of the SRP-LR. The staff also examined the procedures and tools used for this purpose. Trending of the analysis results is performed and enhances the applicant's ability to detect aging effects before there is a loss of intended function. On this basis, the staff finds that the monitoring and trending is acceptable.

[Acceptance Criteria] The applicant stated for the oil analysis program that particle concentration limits are based on industry standards and water concentration will not exceed 0.1%. Viscosity bands are based on a tolerance of 10% around the base viscosity of the lubricating oil. Metal limits by spectral analysis and ferrography are based on original baseline data and manufacturer's recommendations.

The staff confirmed that this program element satisfies the criteria defined in Appendix A.1 of the SRP-LR. Any contaminant values that are projected to exceed limits (determined on the basis of the applicable standards and manufacturers' recommendations documented in the implementing procedures), result in the implementation of corrective measures. On this basis, the staff finds the acceptance criteria acceptable.

[Operating Experience] The applicant stated, in Appendix B, Section B.1.17, of the LRA, that condition report trending data does not identify a need for improvements to this program.

The staff has reviewed past test results and noted that the data are maintained within specifications. That evaluation concluded that the oil analysis program is being implemented as described in plant procedures and is an effective preventive maintenance program. During the audit, the staff reviewed more recent data on oil in contact with components subject to aging management and confirmed that lubricating oils continue to be maintained free of excess water and contamination. Proper additives remain present to neutralize acids that may form during component operation. This operating experience indicates that the program has maintained the quality of lubricating oils within specified limits to mitigate aging effects that could compromise the intended functions of components in this environment.

On the basis of its review of the above operating experience and on the discussions with the applicant's technical staff, the staff finds that the oil analysis program adequately manages the aging effects that have been observed at the applicant's plant and can do so during the period of extended operation.

UFSAR Supplement

In Appendix A, Section A.2.1.18, of the LRA, the applicant provided the UFSAR supplement for the oil analysis program and stated that the program ensures the oil environment in mechanical systems in the scope of license renewal is maintained to the required quality. By monitoring oil quality, the program maintains oil systems free of contaminants (primarily water and particulates) thereby preserving an environment that is not conducive to loss of material, cracking, or fouling. The staff reviewed this section and determined that the information in the UFSAR supplement provides an adequate summary of the program activities, as identified in the SRP-LR UFSAR supplement table and as required by 10 CFR 54.21(d).

Conclusion

On the basis of its review and audit of the applicant's program, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.3.7 Periodic Surveillance and Preventive Maintenance

Summary of Technical Information in the Application

The applicant's periodic surveillance and preventive maintenance program is described in LRA Section B.1.18, "Periodic Surveillance and Preventive Maintenance." In the LRA, the applicant stated that the program is plant-specific. This AMP is credited with performing periodic inspections and tests that are relied on to manage aging effects that are not managed by other AMPs. The periodic inspections and tests are generally implemented through repetitive tasks or routine monitoring of plant operations.

Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in Appendix B, Section B.1.18, of the LRA regarding the applicant's demonstration of the periodic surveillance and preventive maintenance program to ensure that the effects of aging, as discussed above, will be adequately managed so that the intended functions will be maintained consistent with the CLB throughout the period of extended operation.

The staff reviewed the periodic surveillance and preventive maintenance program against the AMP elements found in the SRP-LR, Appendix A, Section A.1.2.3, and SRP-LR Table A.1-1 and focused on how the program manages aging effects through the effective incorporation of 10 elements (i.e., program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience.)

The applicant indicated that the corrective actions, confirmation process, and administrative controls are part of the site-controlled quality assurance program. The staff's evaluation of the quality assurance program is provided separately in Section 3.0.4 of this SER. The remaining

seven elements are discussed below.

[Scope of Program] The applicant stated that periodic surveillance and preventive maintenance program encompasses those tasks credited with managing the aging effects identified in the AMRs. The preventive maintenance and surveillance testing activities are generally implemented through repetitive tasks or routine monitoring of plant operations.

The staff examined the applicant's summary engineering report of aging management reviews in which the preventive maintenance and surveillance program is credited for the aging management of a large number of items. Components are identified with this program only if management of one or more of the aging effects to which they are susceptible is not addressed in other AMPs. The following systems credit this program for management of aging effects: (1) emergency core cooling; (2) containment spray; (3) containment cooling; (4) containment penetrations; (5) EDG; (6) chemical and volume control; (7) alternate AC (AAC) diesel generator; (8) halon fire protection and RCP motor oil leakage collection; (9) fuel oil; (10) service water (SW); (11) auxiliary building ventilation; (12) control room ventilation; (13) emergency feedwater; (14) auxiliary building, turbine building, and yard structures; and (15) intake structure and emergency cooling pond.

The staff confirmed that the program scope program element satisfies the criterion defined in Appendix A.1 of the SRP-LR. The proposed scope identifies the specific components for which the program manages aging. On this basis, the staff finds that the applicant's proposed program is acceptable.

[Preventive Action] The applicant stated that the inspections and testing activities used to identify component aging effects do not prevent aging effects. However, the activities are intended to prevent failures of components that might be caused by aging effects.

The staff confirmed that the preventive actions program element satisfies the criterion defined in Appendix A.1 of the SRP-LR. The periodic surveillance and preventive maintenance program activities are intended to identified component aging effect and prevent failures of components that might be caused by aging effects and is consistent with Branch Technical Position RLSB-1. On this basis, the staff finds the preventive action acceptable.

[Parameters Monitored/Inspected] The applicant stated that this program provides instructions for monitoring SSCs to detect degradation. Inspection and testing activities monitor various parameters including system flow, system pressure, surface condition, loss of material, presence of corrosion products, and signs of cracking.

The staff sampled components in the engineered safety features systems and auxiliary systems. Periodic surveillance and preventive maintenance program activities that are credited for aging management were reviewed according to their associated repetitive task numbers. The applicant's commitment tracking system has been invoked to ensure that the surveillance and preventive maintenance requirements will remain subject to appropriate administrative controls. The applicant's method of controlling such commitments was examined in sufficient detail to permit confidence that once correctly identified, parameters relevant to extended operation would be monitored as required. For those components audited, the parameters monitored were reviewed and determined to be closely linked to the intended function of components managed under the periodic surveillance and preventive maintenance program.

The inspection and testing activities are planned so as to detect the presence and extent of aging effects.

The staff confirmed that this program element satisfies the criteria defined in Appendix A of the SRP-LR. On the basis of interviews with the applicant's technical staff, the staff finds the applicant's parameters monitored or inspected to be acceptable.

[Detection of Aging Effects] The applicant stated, for the periodic surveillance and preventive maintenance program, that

(1) Preventive maintenance activities provide for periodic component inspections and testing to detect aging effects. Inspection intervals are established such that they provide for timely detection of degradation. Inspection intervals are dependent on the component material and environment and take into consideration industry and plant-specific operating experience and manufacturer's recommendations.

(2) The extent and schedule of inspections and testing assure detection of component degradation prior to loss of intended functions. Established techniques such as visual inspections are used.

(3) Containment spray system pump seal heat exchanger testing manages fouling on the borated water side of the heat exchanger tubing. Containment sump inspection manages loss of material on stainless steel components in the containment sump. Emergency diesel generator maintenance inspections manage loss of material (including that due to selective leaching), cracking, fouling, and change in material properties for various materials. Emergency diesel generator surveillance testing manages fouling on air and treated water sides of the EDG air cooler heat exchangers. Chemical and volume control system periodic surveillance testing manages loss of material of charging pump casings. AAC diesel generator maintenance inspections manage loss of material (including that due to selective leaching), cracking, and change in material properties for various materials. AAC diesel generator surveillance testing manages fouling on heat exchanger tubing of the engine cooling water radiator, aftercooler heat exchanger, and lube oil heat exchanger. The CPC room halon system visual inspection manages loss of material for external and internal surfaces of carbon steel components. The RCP motor oil leakage collection system visual inspection manages loss of material for carbon steel and stainless steel components. Maintenance inspections of fuel oil system components manage loss of material, cracking, and change in material properties for various materials. Diesel generator surveillance testing manages fouling on the heat exchanger tubing of the diesel fuel oil return cooler. Service water system surveillance testing manages loss of material on bolting, filters, and pump casings. Auxiliary building ventilation system testing manages fouling on both the water and air sides of copper alloy cooling coils, and loss of material for external copper alloy cooling coil surfaces and for internal surfaces of the carbon steel cooling coil housing. Auxiliary building ventilation system testing manages change in material properties and cracking of elastomer flexible connections. Control room ventilation system testing manages loss of material and fouling for copper alloy, carbon steel, and stainless steel components. Control room ventilation system testing manages cracking and change in material properties of elastomer flexible connections. Emergency feedwater system testing and inspections manage loss of material and fouling on carbon

steel and copper components in the emergency feedwater system. Battery rack inspection manages loss of material for in-scope battery racks.

(4) Low pressure safety injection (LPSI) and high-pressure safety injection (HPSI) pump surveillance testing currently manages fouling on the borated water side of heat exchanger tubing of LPSI and HPSI pump seal coolers and fouling on the raw water side of HPSI pump bearing housings internal surfaces. For license renewal, the program will additionally inspect the interior of the bearing housings for the HPSI pumps for loss of material (including that due to selective leaching). Acceptance criteria and corrective actions for this enhancement will be specified.

(5) Periodic inspection of the external (air) side of containment SW cooling coils currently manages fouling and loss of material for the copper alloy cooling coils. For license renewal, the work orders for cleaning and inspecting the cooling coils of 2VCC-2A/B/C/D will be enhanced to include inspections to confirm the following conditions: no corroded parts or areas; and no accumulation of dirt or sludge that would affect the cooling ability of the coils.

(6) Periodic inspection of the interior and exterior of the cooling coil housing currently manages the effect of loss of material on carbon and stainless steel components. This includes inspection of the housing floor, coils, coil mounting bolts, frame, drain pans, and flanges. For license renewal, the work orders for cleaning and inspecting the housings of 2VCC-2A/B/C/D will be enhanced to include inspections of the interior and exterior of the housings to confirm the following conditions: no degradation of housing floor that would impact seismic qualification or affect required pressure boundary; no loose or degraded upper or lower coil mounting fasteners that would allow the coil to fall and block the drop-out dampers if an earthquake were to occur; and no significant corrosion or degradation of exterior surfaces, including the flanges of the SW coils, that could affect coil seismic qualification, required pressure boundary, or the ability to transfer the required heat load.

(7) During the monthly electrical penetration nitrogen leak rate test, if bottle pressure is too low, the bottles are replaced. The elastomer flex hoses in the electrical penetration nitrogen pressurization system are checked for cracking and change in material properties during replacement of nitrogen bottles.

(8) Annual emergency cooling pond sounding manages loss of form for the emergency cooling pond natural soils. Accessible and exposed surfaces are visually inspected along with sounding for pond level. Areas of the cooling pond are inspected for excessive erosion, degradation of riprap, or silt buildup.

During its review, the staff requested that the applicant identify how specific aging effects are detected and the associated technical basis, because different aging mechanisms require different detection methods. The staff requested that the applicant provide the emergency diesel generator maintenance inspections and emergency diesel generator surveillance testing as examples.

In its response dated July 22, 2004, the applicant provided a table listing the aging effect detection methods for aging effects such as loss of material (including that due to selective

leaching), cracking, fouling, and change in material properties, and the technical basis for emergency diesel generator maintenance inspections. On the basis that the applicant provided adequate technical justification for the aging effect detection methods, the staff finds this acceptable.

Additionally, the staff asked the applicant to clarify, with regard to the chemical and volume control system (CVCS) periodic surveillance testing, what specific inspections or tests are conducted to assure that aging is not occurring in the charging pump casings, and to identify the frequency and acceptance criteria applicable to this surveillance testing. The staff also asked the applicant to identify specific criteria and operating experience that demonstrate loss of material in the charging pump casings is being effectively managed.

In its response dated July 22, 2004, the applicant provided the parameters monitored, detection of aging effects, monitoring and trending, acceptance criteria, and operating experience for loss of material due to wear and cracking due to fatigue aging effects for the CVCS charging pump casings. On the basis that the applicant provided the inspections and tests, acceptance criteria, and operating experience related to loss of material and cracking aging effects for the CVCS charging pump casings, the project team finds this acceptable.

The staff observed that measurements and inspections of other selected systems' surveillances use a frequency and sample size based on operating experience to detect the presence and extent of aging effects. The staff confirmed that this program element satisfies the criteria defined in Appendix A.1 of the SRP-LR. On the basis of its review of the applicant's responses, the staff finds that the detection of aging effects is acceptable.

[Monitoring and Trending] The applicant stated that preventive maintenance and surveillance testing activities provide for monitoring and trending of aging degradation. Inspection and testing intervals are established such that they provide for timely detection of component degradation. Inspection and testing intervals are dependent on the component material and environment and take into consideration industry and plant-specific operating experience and manufacturers' recommendations.

The staff confirmed that this program element satisfies the criteria defined in Appendix A.1 of the SRP-LR. The staff noted that there are specific activities that will not be within the scope of the program until the license is renewed. The staff reviewed the applicant's commitment management program, which is used to ensure that these changes will be properly implemented, as well as the specific record originated to track the implementation of modifications necessitated by license renewal. Trending of the inspection results will enhance the applicant's ability to detect aging effects before there is a loss of intended function. On the basis of its review of the monitoring and trending, the staff finds it acceptable.

[Acceptance Criteria] The applicant stated that the periodic surveillance and preventive maintenance program acceptance criteria are defined in specific inspection and testing procedures. The acceptance criteria confirm component integrity by evaluating the absence of aging effect or by comparing applicable parameters to limits based on applicable intended functions established by the plant design basis.

The staff confirmed that this program element satisfies the criteria defined in Appendix A of the SRP-LR. The staff reviewed a selection of the repetitive tasks and associated procedures. In

all cases where an aging effect had been identified, appropriate acceptance criteria were provided. While this offers some confidence that additional aging effects will be appropriately monitored, the codes and/or standards to be applied (and methods of assessment) have yet to be specified for the full license renewal scope. On the basis of its review of the applicant's acceptance criteria program element, the staff finds that any degradation to component integrity below the minimum allowable is unacceptable and corrective measures are implemented. On this basis, the staff finds the acceptance criteria program element to be acceptable.

[Operating Experience] The applicant stated that the plant's history of successful operation demonstrates that typical surveillance and preventive maintenance activities have been effective in managing the effects of aging on components.

The staff reviewed the applicant's programmatic experience with surveillance and maintenance activities. Although numerous deficiencies were identified, corrective actions were implemented and their effectiveness has been documented. This supports the conclusion that the program has been effective and will support license renewal. The applicant also stated that the plant corrective action program, which captures internal and external plant operating experience issues, provides assurance that operating experience will be reviewed in the future to provide objective evidence to support the conclusion that the effects of aging will be adequately managed. On the basis of its review of the above operating experience and on discussions with the applicant's technical staff, the staff concludes that the periodic surveillance and preventive maintenance program adequately manages the aging effects that have been observed at the applicant's plant.

UFSAR Supplement

In Appendix A, Section A.2.1.19, of the LRA, the applicant provided the UFSAR supplement for the periodic surveillance and preventive maintenance program and stated that the program consists of periodic inspections and tests that are relied on to manage aging effects that are not managed by other AMPs. Preventive maintenance and surveillance testing activities provide for periodic component inspections and testing to detect various aging effects applicable to those components included in the program for license renewal. The staff reviewed this section and determined that the information in the UFSAR supplement provides an adequate summary of the program activities, as identified in the SRP-LR UFSAR supplement table and as required by 10 CFR 54.21(d).

Conclusion

On the basis of its review and audit of the applicant's program, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the UFSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.3.8 Pressurizer Examinations Program

Summary of Technical Information in the Application

The applicant's pressurizer examinations program is described in LRA Section B.1.19, "Pressurizer Examinations." In the LRA, the applicant stated that the program is plant-specific. The AMP is credited with identification of pressurizer cladding cracking, which could potentially cause loss of intended function of the pressurizer.

Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in Appendix B, Section B.1.19, of the LRA, regarding the applicant's demonstration of the pressurizer examinations program to ensure that the effects of aging, as discussed above, will be adequately managed so that the intended functions will be maintained consistent with the CLB throughout the period of extended operation.

The staff reviewed the pressurizer examinations program against the AMP elements found in the SRP-LR, Appendix A, Section A.1.2.3, and SRP-LR Table A.1-1 and focused on how the program manages aging effects through the effective incorporation of 10 elements (i.e., program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience.)

The applicant indicated that the corrective actions, confirmation process, and administrative controls are part of the site-controlled quality assurance program. The staff's evaluation of the quality assurance program is provided separately in Section 3.0.4 of this SER. The remaining seven elements are discussed below.

[Program Scope] The applicant stated, in Appendix B, Section B.1.19, of the LRA, that the pressurizer examinations program will manage cracking of the stainless steel and nickel-based alloy cladding and attachment welds to the cladding of the pressurizer by examination of the adjacent base metal. The pressurizer shell and upper head are clad with austenitic stainless steel. The lower head is clad with nickel-based alloy.

During the audit, in RAI B.1.19-1, the staff asked the applicant to confirm that the pressurizer examinations program comprises activities performed under the existing inservice inspection program, and if it is an existing program, to update the UFSAR supplement, LRA Section A.2.1.20.

In its response to RAI B.1.19-1, by letter dated July 22, 2004, the applicant stated that the pressurizer examinations program comprises activities performed under the existing inservice inspection program and that, upon incorporation into the safety analysis report, the UFSAR supplement LRA Section A.2.1.20 will be revised to indicate that the pressurizer examinations program is an existing program. On the basis of its review of the applicant's response, the staff finds this acceptance, and the RAI is resolved.

The staff confirmed that the program scope program element satisfies the criterion defined in Appendix A.1 of the SRP-LR. The proposed scope identifies the specific components for which

the program manages aging. On this basis, the staff finds that the applicant's proposed program scope is acceptable.

[Preventive Actions] The applicant stated the pressurizer examinations program is an inspection program and that no actions will be taken as part of this program to prevent aging effects or mitigate aging degradation. However, the applicant added that the its water chemistry control program includes effective actions to avoid SCC of the cladding and attachment welds.

The staff confirmed that the preventive actions program element satisfies the criterion defined in Appendix A.1 of the SRP-LR. The staff did not identify the need for preventive actions for this program because it is a condition monitoring program.

[Parameters Monitored] The applicant stated that (1) in order to provide assurance that cracking of the pressurizer cladding has not propagated into the underlying base metal of the pressurizer, volumetric examination of pressurizer items that are susceptible to cracking will be performed. Cracking of the pressurizer stainless steel cladding would most likely result from thermal fatigue and cracking of the nickel-based alloy cladding would most likely result from primary water SCC and fatigue. The pressurizer pressure boundary items with high fatigue cumulative usage factors include the circumferential weld at the head-to-shell junction and the surge nozzle to shell junction and (2) in accordance with ASME Section XI, Examination Category B-B, volumetric examination of essentially 100% of the circumferential shell-to-head weld will be performed. In addition, the weld metal between the surge nozzle and the vessel lower head will be subjected to high stress cycles. Periodic monitoring of this area provides monitoring for cracking of the nickel-based alloy cladding that may propagate to the underlying ferritic steel. The weld that connects the surge nozzle to the lower head will receive volumetric examination in accordance with Examination Category B-D. These examinations will continue through the period of extended operation to manage cracking of cladding that may extend into the base metal at susceptible locations.

The staff confirmed that this program element satisfies the criteria defined in Appendix A of the SRP-LR. The evaluations of cladding and weld integrity are intended to detect the presence and extent of aging effects. On this basis, the staff finds that the parameters monitored or inspected are acceptable.

[Detection of Aging Effects] The applicant stated that detection of cracking in the pressurizer cladding will be achieved through periodic volumetric inspections of the base metal as required by ASME Section XI. Inspection of these items constitutes an appropriate sample of the remaining stainless steel and nickel-based alloy clad items in the pressurizer. Information in Table IWB 2500-1 describes the inspection sampling requirements, the examination methods, and the examination frequencies for the pressurizer. Detection of cracking will be achieved through periodic volumetric inspections as required by ASME Section XI.

The staff confirmed that this program element satisfies the criteria defined in Appendix A.1 of the SRP-LR. The applicant stated that inspections will use a frequency and sample size based on existing codes and operating experience, to detect the presence and extent of aging effects. On this basis, the staff finds that the detection of aging effects is acceptable.

[Monitoring and Trending] The applicant stated that (1) during the course of the inspections, the extent of surface or volumetric flaws will be characterized by non-destructive examinations. Anomalous indications that are signs of degradation will be recorded on non-destructive examination reports in accordance with plant procedures and (2) the corrective action program and the requirements of ASME Section XI will address trending of flaws detected.

The staff confirmed that this program element satisfies the criteria defined in Appendix A of the SRP-LR. Trending of the inspection results will enhance the applicant's ability to detect aging effects before there is a loss of intended function. On this basis, the staff finds that the monitoring and trending is acceptable.

[Acceptance Criteria] The applicant stated that acceptance criteria for volumetric examinations will be in accordance with ASME Section XI, IWB-3510 and IWB-3512.

The staff confirmed that this program element satisfies the criteria defined in Appendix A.1 of the SRP-LR. The staff finds that any volumetric examination results that fall below the minimum allowable, as determined by the applicable design code, will be found unacceptable and corrective measures implemented. On that basis, the staff finds that the acceptance criteria is acceptable.

[Operating Experience] The applicant stated, in Appendix B, Section B.1.19, of the LRA, that its pressurizer examinations program is a new program for which there is no operating experience. The program will include volumetric examinations of pressurizer items having high susceptibility to thermal fatigue. Cracking of the cladding that extends into the base metal will be detected by ASME Section XI volumetric examinations at these locations. The volumetric inspections will be performed with ISI techniques that have been proven effective within the industry at detecting cracking before loss of function occurs.

In the LRA, the applicant stated that the program is based on proven ISI techniques that can effectively manage cracking of pressurizer cladding. This program will provide assurance that the aging effects will be managed so that the pressurizer will continue to perform its intended functions consistent with the CLB for the period of extended operation.

During the audit, the staff asked the applicant to clarify and/or provide the operating experience reviews for new programs. In its response, the applicant stated that the plant corrective action program, which captures internal and external plant operating experience issues, provides assurance that operating experience will be reviewed and incorporated in the future to provide objective evidence to support the conclusion that the effects of aging will be adequately managed.

The staff agrees that even though limited operating experience was available, the pressurizer examinations program provided assurance that the applicable aging effects would be adequately managed for the period of extended operation.

UFSAR Supplement

In Appendix A, Section A.2.1.20, of the LRA, the applicant provided the UFSAR supplement for the pressurizer examinations program and stated that the program will use volumetric examinations required by ASME Section XI to manage cracking of the stainless steel and

nickel-based alloy cladding and attachment welds to the cladding which may propagate into the underlying ferritic steel. Volumetric examination of the circumferential shell-to-head weld and the weld metal between the surge nozzle and the vessel lower head will be performed each ISI inspection interval. The applicant stated in Appendix A that the pressurizer examinations program will be implemented prior to the period of extended operation. As stated in its response to RAI B.1.19-1, the applicant stated that UFSAR supplement A.2.1.20 will be revised to indicate that the pressurizer examinations program is an existing program. The staff reviewed this section and determined that the information in the UFSAR supplement provides an adequate summary of the program activities, as identified in the SRP-LR UFSAR supplement table and as required by 10 CFR 54.21(d).

Conclusion

On the basis of its review and audit of the applicant's program, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.3.9 System Walkdown Program

Summary of Technical Information in the Application

The applicant's system walkdown program is described in LRA Section B.1.28, "System Walkdown." In the LRA, the applicant stated that the program is plant-specific. The AMP is credited with managing aging effects on systems and components within the scope of license renewal and subject to aging management review.

Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in Appendix B, Section B.1.19, of the LRA, regarding the applicant's demonstration of the system walkdown program to ensure that the effects of aging, as discussed above, will be adequately managed so that the intended functions will be maintained consistent with the CLB throughout the period of extended operation.

The staff reviewed the system walkdown program against the AMP elements found in the SRP-LR, Appendix A, Section A.1.2.3, and SRP-LR Table A.1-1 and focused on how the program manages aging effects through the effective incorporation of 10 elements (i.e., program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience.)

The applicant indicated that the corrective actions, confirmation process, and administrative controls are part of the site-controlled quality assurance program. The staff's evaluation of the quality assurance program is provided separately in Section 3.0.4 of this SER. The remaining seven elements are discussed below.

[Program Scope] The applicant stated, in Appendix B, Section B.1.28, of the LRA, that the system walkdown program includes inspections of external surfaces of ANO-2 components within the scope of license renewal and subject to an aging management review. The program is credited with managing loss of material from internal surfaces for situations in which the external surface condition is representative of the internal surface condition and both have the same environment. The program is also credited with detecting leakage and spray from liquid-filled low-energy systems before such leakage can prevent satisfactory accomplishment of safety functions.

The staff confirmed that the program scope program element satisfies the criterion defined in Appendix A.1 of the SRP-LR. The proposed scope identifies the specific components for which the program manages aging. On this basis, the staff finds that the applicant's proposed program scope is acceptable.

[Preventive Actions] The applicant stated that the system walkdown program is an inspection program and no actions will be taken as part of this program to prevent or mitigate aging degradation.

The staff confirmed that the program element satisfies the criterion defined in Appendix A.1 of the SRP-LR. The staff did not identify the need for preventive actions since the system walkdown program is a condition monitoring program.

[Parameters Monitored/Inspected] The applicant stated that during a walkdown, the engineer monitors for items which could affect system performance, safety, or reliability as well as general housekeeping, personnel safety hazards, and radiological concerns. Examples of parameters inspected during the system walkdown are condition and placement of coatings, evidence of corrosion, and indications of leakage.

The staff confirmed that this program element satisfies the criteria defined in Appendix A.1 of the SRP-LR. The system walkdown activities are intended to detect the presence and extent of aging effects. On this basis, the staff finds that the parameters monitored or inspected is acceptable.

[Detection of Aging Effects] The applicant stated (1) a general visual inspection is conducted on readily accessible system and component surfaces during walkdowns, (2) component walkdowns are performed periodically at a frequency dependent on the component being inspected and (3) for each system that credits the program, system engineers are expected to perform a walkdown at least once per refueling cycle. The frequency of inspection is acceptable because aging effects are typically caused by relatively long-term degradation mechanisms such as corrosion.

The staff confirmed that this program element satisfies the criteria defined in Appendix A.1 of the SRP-LR. The walkdowns are conducted, using a frequency and sample size based on operating experience, to detect the presence and extent of aging effects. On that basis, the staff finds that the detection of aging effects is acceptable.

[Monitoring and Trending] The applicant stated that (1) the program uses standardized monitoring and trending activities to track degradation. Deficiencies are documented so that results can be trended. In addition to preparing a written description and noting the location,

this may also include collecting measurements to determine the severity of deterioration, taking photographs, or drawing sketches and (2) component inspections are conducted by qualified engineers using predefined checklists. Personnel are qualified in accordance with the engineering support personnel training program that provides assurance of an appropriate level of knowledge and experience prior to performing engineering activities.

The staff confirmed that this program element satisfies the criteria defined in Appendix A of the SRP-LR. Trending of the inspection results will enhance the applicant's ability to detect aging effects before there is a loss of intended function. On this basis, the staff finds that the monitoring and trending is acceptable.

[Acceptance Criteria] The applicant stated that, for the system walkdown program, all unacceptable visual indications of cracking, loss of material, or change of material properties of components are documented as deficiencies.

The staff confirmed that this program element satisfies the criteria defined in Appendix A.1 of the SRP-LR. The staff finds that any deficiencies will be found unacceptable and corrective measures implemented. On this basis, the staff finds that the acceptance criteria is acceptable.

[Operating Experience] The applicant stated, in Appendix B, Section B.1.28, of the LRA, that the condition reports document conditions identified during walkdowns, including instances of corrosion, paint flaking, excessive wear, plant environment issues, leakage, loose parts, bent or broken parts, and numerous other material conditions. Condition report trending data did not identify a need for improvement to this program. Operating experience demonstrated that under the program coating deficiencies, evidence of corrosion, and indications of leakage were being adequately detected and corrective action was initiated as required. The applicant also stated that the plant corrective action program, which captures internal and external plant operating experience issues, provides assurance that operating experience will be reviewed in the future to provide objective evidence to support the conclusion that the effects of aging will be adequately managed.

On the basis of its review of the above operating experience on the discussions with the applicant's technical staff, the staff finds that the system walkdown program adequately manages the aging effects that have been observed at the applicant's plant and can do so during the period of extended operation.

UFSAR Supplement

In Appendix A, Section A.2.1.29, of the LRA, the applicant provided the UFSAR supplement for the system walkdown program and stated that the program conducts inspections to manage loss of material, loss of mechanical closure integrity, and cracking, as applicable, for SCs within the scope of license renewal. The program uses general visual inspections of readily accessible system and component surfaces during system walkdowns. The staff reviewed this section and determined that the information in the UFSAR supplement provides an adequate summary of the program activities, as identified in the SRP-LR UFSAR supplement table and as required by 10 CFR 54.21(d).

Conclusion

On the basis of its review and audit of the applicant's program, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.3.10 Wall Thinning Monitoring Program

Summary of Technical Information in the Application

The applicant's wall thinning monitoring program is described in LRA Section B.1.29, "Wall Thinning Monitoring." In the LRA, the applicant stated that the program is plant-specific and is credited with ensuring that wall thickness is above the minimum required in order to avoid failures under normal, transient, and accident conditions, including seismic events.

Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in Appendix B, Section B.1.19, of the LRA, regarding the applicant's demonstration of the wall thinning monitoring program to ensure that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB throughout the period of extended operation.

The staff reviewed the wall thinning monitoring program against the AMP elements found in the SRP-LR, Appendix A, Section A.1.2.3, and SRP-LR, Table A.1-1 and focused on how the program manages aging effects through the effective incorporation of 10 elements (i.e., program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience.)

The applicant indicated that the corrective actions, confirmation process, and administrative controls are part of the site-controlled quality assurance program. The staff's evaluation of the quality assurance program is provided separately in Section 3.0.4 of this SER. The remaining seven elements are discussed below.

[Scope of Program] The applicant stated, in Appendix B, Section B.1.29, of the LRA, that the wall thinning monitoring program encompasses wall thinning monitoring inspections for carbon and stainless steel components.

The staff confirmed that the program scope program element satisfies the criterion defined in Appendix A.1 of the SRP-LR. The proposed scope identifies the specific components for which the program manages aging. On this basis, the staff finds that the applicant's proposed program scope is acceptable.

[Preventive Actions] The applicant stated the wall thinning monitoring program is an inspection program and no actions will be taken as part of this program to prevent or mitigate degradation due to aging.

The staff confirmed that the preventive actions program element satisfies the criterion defined in Appendix A.1 of the SRP-LR. The staff did not identify the need for preventive actions for the wall thinning monitoring program since it is a condition monitoring program.

[Parameters Monitored] The applicant stated that non-destructive examinations will be performed on susceptible components to determine wall thickness.

The staff confirmed that this program element satisfies the criteria defined in Appendix A.1 of the SRP-LR. During the audit, the staff observed that the applicant did not identify the parameters monitored nor the type of non-destructive examinations to be performed. By letter dated January 22, 2004, the applicant stated that the wall thinning program was modified to identify that the parameter monitored will be wall thickness. In its letter, the applicant also stated that the wall thinning program was modified to reflect that non-destructive examinations using industry-accepted methods such as ultrasonic testing will be performed on susceptible components to determine wall thickness. The parameters monitored or inspected program element is acceptable because the measurements of wall thickness are intended to detect the presence and extent of aging effects. On this basis, the staff finds that the parameters monitored or inspected is acceptable.

[Detection of Aging Effects] The applicant stated that (1) the aging effect being managed by this program is loss of material. An appropriate sample size will be determined based on operating experience prior to these inspection activities. The extent and schedule of the examinations prescribed by the program will be designed to ensure that aging effects will be discovered and repaired before loss of intended function and (2) inspections will be performed periodically at a frequency to be determined prior to implementation. The frequency of inspections will depend upon results of previous inspections, calculated rate of material loss, and industry and plant operating experience.

The staff confirmed that this program element satisfies the criteria defined in Appendix A.1 of the SRP-LR. However, the staff observed that applicant did not specify the type of non-destructive examinations to be performed. By letter dated January 22, 2004, the applicant stated that the wall thinning program was modified to reflect that non-destructive examinations using industry-accepted methods such as ultrasonic testing will be performed on susceptible components to determine wall thickness. The staff finds, based on its review of the detection of aging effects program element and the applicant's January 22, 2004 letter, that the detection of aging effects program element is acceptable because the inspections will be developed, using a frequency and sample size based on operating experience, to detect the presence and extent of aging effects. With this additional information the staff finds that the criteria of SRP-LR Appendix A.1 are satisfied and so the program element is acceptable.

[Monitoring and Trending] The applicant stated that wall thickness will be trended and projected to the next inspection, and corrective actions will be taken if the projections indicate that the acceptance criteria of minimum wall thickness may not be met at the next inspection.

The staff confirmed that this program element satisfies the criteria defined in Appendix A of the SRP-LR. Trending of the inspection results will enhance the applicant's ability to detect aging effects before there is a loss of intended function. On this basis, the staff finds that the monitoring and trending is acceptable.

[Acceptance Criteria] The applicant stated that wall thickness measurements greater than minimum wall thickness values for the components' design code of record will be acceptable.

The staff confirmed that this program element satisfies the criteria defined in Appendix A.1 of the SRP-LR. The staff finds that any wall thickness values that are projected to fall below the minimum allowable, as determined by the applicable design code, will be found unacceptable and corrective measures implemented. On this basis, the staff finds that the acceptance criteria is acceptable.

[Operating Experience] The applicant stated, in Appendix B, Section B.1.29, of the LRA, that wall thinning monitoring program is a new program for which there is no operating experience.

The staff observed that ultrasonic wall thickness examinations are consistent with industry standards and the applicant had indicated that if initial or periodic examinations reveal the need to expand the sample size or increase the frequency of these activities, such actions would occur. The operating experience associated with the wall thinning monitoring program will be accrued over the period of extended operation.

During the audit, the staff asked the applicant to clarify and/or provide the operating experience reviews for new programs. In its response, the applicant stated that the plant corrective action program, which captures internal and external plant operating experience issues, provides assurance that operating experience will be reviewed and incorporated in the future to provide objective evidence to support the conclusion that the effects of aging will be adequately managed.

The staff agrees that even though limited operating experience was available, the wall thinning program provides assurance that the applicable aging effects would be adequately managed for the period of extended operation.

UFSAR Supplement

In Appendix A, Section A.2.1.30, of the LRA, the applicant provided the UFSAR supplement for the wall thinning monitoring program and stated that it will manage loss of material from components, as applicable, within the scope of license renewal. Inspections will be performed to ensure wall thickness is above the minimum required in order to avoid failures. The applicant stated in Appendix A that the wall thinning monitoring program will be initiated prior to the period of extended operation. The staff reviewed this section and determined that the information in the UFSAR supplement provides an adequate summary of the program activities, as identified in the SRP-LR UFSAR supplement table and as required by 10 CFR 54.21(d).

Conclusion

On the basis of its review and audit of the applicant's program, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended

functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.3.11 Auxiliary Systems Water Chemistry Control Program

Summary of Technical Information in the Application

The applicant's auxiliary systems water chemistry control program is described in LRA Section B.1.30.1, "Auxiliary Systems Water Chemistry Control." In the LRA, the applicant stated that the program is plant-specific and is credited with managing loss of material, cracking, and fouling of components exposed to treated water environments.

Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in Appendix B, Section B.1.30.1, of the LRA, regarding the applicant's demonstration of the auxiliary systems water chemistry control program to ensure that the effects of aging, as discussed above, will be adequately managed so that the intended functions will be maintained consistent with the CLB throughout the period of extended operation.

The staff reviewed the auxiliary systems water chemistry control program against the AMP elements found in the SRP-LR, Appendix A, Section A.1.2.3 and SRP-LR Table A.1-1 and focused on how the program manages aging effects through the effective incorporation of 10 elements (i.e., program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience.)

The applicant indicated that the corrective actions, confirmation process, and administrative controls are part of the site-controlled quality assurance program. The staff's evaluation of the quality assurance program is provided separately in Section 3.0.4 of this SER. The remaining seven elements are discussed below.

[Scope of Program] The applicant stated, in Appendix B, Section B.1.30.1, of the LRA, that the auxiliary systems water chemistry control program encompasses sampling activities that include analyses on the EDG and AAC diesel generator cooling water systems. In addition, the program includes chemistry monitoring and inspection activities on selected systems included in the scope of license renewal due to possible spatial interactions with safety-related systems. These are systems containing treated water that are not covered by other chemistry programs.

The applicant stated that LRA Section 2.3.3.11 contains the non-safety-related SCs. In Section 2.3.3.11 of the LRA, the applicant described the systems that are in-scope for 10 CFR 54.4(a)(2). Specifically, LRA Table 2.3.3-11, "Miscellaneous Systems in scope for 10 CFR 54.4(a)(2) Components Subject to Aging Management Review," described non-safety-related system components. LRA Table 3.3.2-11, "Miscellaneous Systems in scope for 10 CFR 54.4(a)(2) Summary of Aging Management Evaluation," identifies component types that credit the auxiliary systems water chemistry control program as an AMP.

The staff confirmed that the program scope program element satisfies the criterion defined in Appendix A.1 of the SRP-LR. The proposed scope identifies the specific components for which the program manages aging. On this basis, the staff finds that the applicant's proposed program scope is acceptable.

[Preventive Actions] The applicant stated that this program monitors and controls water chemistry in the cooling water systems to manage the effects of aging.

The staff confirmed that the preventive actions program element satisfies the criterion defined in Appendix A.1 of the SRP-LR. On the basis of its audit of the implementation procedures and review of the program basis documents, the staff finds that preventive actions program element is acceptable because it identifies and describes the activities from managing aging effects.

[Parameters Monitored/Inspected] The applicant stated that the program inspects components for visible corrosion, deposits, structural damage, and biological growth. The systems are inspected when opened for maintenance. The program typically monitors pH, conductivity, solids, hardness, nitrite, freeze point, and biological count.

During its audit, the staff asked the applicant to (1) clarify whether iron and copper are monitored in the applicant's auxiliary systems water chemistry control program, and (2) discuss whether the parameters monitored/inspected under this program are consistent with the industry guidance credited. The applicant stated that iron and copper are monitored under the program, and that the program covers a wide variety of equipment and parameters that are monitored/inspected in accordance with vendor recommendations for the individual components. The component inspections and water chemistry monitoring activities are intended to detect the presence and extent of aging effects.

During its audit, the staff asked the applicant to (1) discuss the systems and components that have been inspected (i.e., scope of inspection) under the auxiliary system water chemistry control program (AMP B.1.30.1) in the past and which systems and components would be inspected during the extended period of operation; and (2) discuss whether any systems covered under this program have never been inspected and whether component failures (e.g., leakage) have occurred in these systems.

In its response dated May 19, 2004, the applicant stated that visual inspections have been performed on components in the emergency diesel generator, condensate storage, feedwater, chilled water, and main steam systems during disassembly for various reasons. A number of components such as piping, tanks, heat exchangers and valves that are managed by the auxiliary systems water chemistry control program have been inspected on both the emergency diesel generators and the AAC diesel generator. Many of the components in these cooling water systems are subject to inspection on a routine basis and, as a result, will be inspected during the period of extended operation.

In its response dated May 19, 2004 to the second question above, the applicant stated that during operation, all systems with components that rely only on the auxiliary systems water chemistry control program for managing aging effects have been inspected during maintenance. If leakage were to occur in a system covered by this program, it would have been opened during maintenance to repair the leak and, therefore, would have been inspected.

On the basis of its review of the applicant's responses, the staff confirmed that this program element satisfies the criteria defined in Appendix A.1 of the SRP-LR and finds that the parameters monitored or inspected program element is acceptable.

[Detection of Aging Effects] The applicant stated that this program manages aging effects in the systems included in the scope.

The staff confirmed that this program element satisfies the criteria defined in Appendix A.1 of the SRP-LR. In its engineering report, the applicant stated that the aging effects being managed include loss of material (including that due to selective leaching) from the components containing treated water in the emergency diesel generator system; fouling of the heat exchanger tubes of the emergency diesel generator system; loss of material (including that due to selective leaching) from the alternate AC diesel generator components exposed to treated water; fouling on the heat exchanger tubes of the alternate AC diesel generator system; and loss of material and cracking for certain systems containing treated water. The staff reviewed the engineering report, and finds that the component inspections are conducted to detect the presence and extent of aging effects. On this basis, the staff finds that the detection of aging effects program element is acceptable.

[Monitoring and Trending] The applicant stated that values from analyses are archived for long-term trending and review.

The staff confirmed that this program element satisfies the criteria defined in Appendix A.1 of the SRP-LR. Trending of the inspection results will enhance the applicant's ability to detect aging effects before there is a loss of intended function. On this basis, the staff finds that the monitoring and trending are acceptable.

[Acceptance Criteria] The applicant stated that the acceptance criteria for chemistry parameters are in accordance with the manufacturer's recommendations or industry guidance. The acceptance criteria for visual inspections are satisfactory general cleanliness and no unacceptable corrosion, deposits, or structural damage.

The staff confirmed that this program element satisfies the criteria defined in Appendix A.1 of the SRP-LR. The staff finds that any inspection results that indicate component degradation or any chemistry parameters that fall outside those contained in applicable industry and manufacturers' guidelines will be found unacceptable and corrective measures implemented.

During the audit, the staff asked the applicant to identify specific industry guidance documents used as the basis for the acceptance criteria.

In its response dated May 19, 2004, the applicant replied that EPRI TR-107396 was used to develop the auxiliary systems water chemistry control program and implementing procedure 1052.027. The applicant further stated that more specific guidance was also used to develop the program, including EPRI NP-5569, "Chromate Substitutes for Corrosion Inhibitors in Cooling Systems"; CE-NPSD-448, "Review of Inhibitors used in Closed Cycle Cooling Water Systems"; EPRI TR-105504, "Primer on Maintaining the Integrity of Water-Cooled Generator Stator Windings"; and the Technical Manual for Alternate AC Diesel Generator System.

On the basis of the applicant's response to the above question and its review, the staff finds the acceptance criteria acceptable.

[Operating Experience] The applicant stated that during the review of the ANO-1 LRA (0CNA040109), the NRC staff reviewed the ANO auxiliary systems water chemistry control program. The governing procedure for the auxiliary systems water chemistry program applies to both units.

The staff asked the applicant to discuss whether there have been any condition reports or licensee event reports related to chemical excursions or component degradation occurring in the systems within the scope of the auxiliary systems water chemistry control program. The applicant responded that the operating experience discussed in its engineering report included a review of condition reports, condition report trending data, and interviews with the applicant's technical staff regarding plant system and program operating experience. The review did not identify any condition reports or licensee event reports related to chemical excursions in the systems covered under this program. Also, the condition report trending data did not identify recurrent component degradation occurring in the systems covered under this program.

On the basis of its review of the above operating experience and on discussions with the applicant's technical staff, the staff concludes that auxiliary systems water chemistry control program adequately manages the aging effects that have been observed at the applicant's plant.

UFSAR Supplement

In Appendix A, Section A.2.1.31, of the LRA, the applicant provided the UFSAR supplement for the water chemistry control – auxiliary systems water chemistry control program and stated that the program manages loss of material, cracking, and fouling, as applicable, of components in the scope of license renewal. The program monitors and controls the relevant chemistry conditions for components exposed to treated water environments.

During the audit, the staff noted that for the water chemistry related systems described in the SRP-LR, Table 3.1-2 and Table 3.3-2, industry guidance and/or reports are identified. The staff requested, in question B.1.30.1-6, that the applicant include in its LRA Section A.2.1.31 specific industry guidance for the auxiliary water chemistry program similar to that in the SRP-LR, Tables 3.1-2 and 3.3-2, or justify not including the industry guidance in this section (RAI B.1.30.1-2).

In its response dated May 19, 2004, the applicant stated that a reference to industry guidance used for the auxiliary systems water chemistry control program will be provided in LRA SAR Section A.2.1.31 and committed to completing this action upon issuance of the renewed license.

The staff asked the applicant to clarify what industry guidance would be referenced. In its subsequent response to the staff's question, by letter dated July 22, 2004, the applicant stated that the auxiliary water systems chemistry control program covers a variety of miscellaneous systems and components using many different references such as EPRI reports, vendor technical manuals, and other industry guidance. Applicable references can change frequently

based on industry experience or component replacements. Since the references change frequently, the staff rescinded its request that the applicant revise the SAR Section A.2.1.31.

On the basis of its review of the applicant's response to the above question, the staff finds that the applicant provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion

On the basis of its review and audit of the applicant's program, the staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the UFSAR supplement for this AMP and finds that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.4 Quality Assurance Program Attributes Integral to Aging Management Programs

The NRC staff has reviewed LRA Appendix A, Section A.2.1, "Aging Management Programs and Activities" and Appendix B, Section B.0.3, "ANO-2 Corrective Actions, Confirmation Process and Administrative Controls," in accordance with the requirements of 10 CFR 54.21(a)(3) and 10 CFR 54.21(d). The staff has evaluated the adequacy of certain aspects of the applicant's programs to manage the effects of aging. The particular aspects reviewed by the staff in this section encompass three quality assurance program attributes, namely corrective actions, confirmation process, and administrative controls. These three attributes of the quality assurance program are addressed for all of the applicant's AMPs.

The license renewal applicant is required to demonstrate that the effects of aging on structures and components that are subject to an AMR will be adequately managed to ensure that their intended functions will be maintained in a manner that is consistent with the CLB of the facility throughout the period of extended operation. To manage these effects, applicants have developed new, or revised existing, AMPs and applied those programs to the SSCs of interest. For each of these AMPs, the existing 10 CFR Part 50, Appendix B, quality assurance program may be used to address the attributes of corrective actions, confirmation process, and administrative controls.

3.0.4.1 Summary of Technical Information in Application

Appendix B, Section B.0.3, "ANO-2 Corrective Actions, Confirmation Process and Administrative Controls," of the LRA provides the aging management activity description for each activity credited for managing aging effects. The applicant stated that it uses the existing ANO-2, 10 CFR Part 50, Appendix B, quality assurance program to address the elements of corrective action, confirmation process, and administrative controls for all of its AMPs. The applicant further states that these programs, credited for license renewal, encompass both the safety-related and non safety-related SSCs within the scope of license renewal.

3.0.4.2 Staff Evaluation

During the audit of the applicant's renewal scoping and screening process, the staff also examined the applicant's processes for addressing corrective action, confirmation processes, and document control (the quality assurance attributes) associated with the various aging management programs credited for managing the potential aging effects of SSCs over the period of extended operation of the plant.

The audit team determined that the applicant had not described the AMP quality attributes in Appendix A, "Updated Final Safety Analysis Report Supplement." Consistent with Branch Technical Position IQMB-1, the applicant should either document a commitment to expand the scope of its 10 CFR Part 50 Appendix B program to include nonsafety-related structures and components subject to an AMP to address the AMP quality attributes during the period of extended operation or propose an alternative means to address this issue. The staff requested that the applicant clarify their commitments related to addressing the quality attributes of AMPs applicable to nonsafety-related structures and components subject to aging management. The description in Appendix A should provide sufficient information for the staff to determine if the quality attributes for the Appendix A.1 aging management programs are consistent with the review acceptance criteria contained in NUREG-1800, Section A.2, "Quality Assurance for Aging Management Programs (Branch Technical Position IQMB-1)." (This request for information was documented as RAI 2.1-6).

The applicant responded by a letter to the NRC dated May 19, 2004. The following paragraph will be added to Appendix A of the LRA. "The Quality Assurance Program implements the requirements of 10CFR50, Appendix B. The Quality Assurance Program includes the elements of corrective action, confirmation process, and administrative controls and is applicable to all aging management programs credited for license renewal including programs for safety-related and non-safety related structures, systems and components."

The staff concluded that the applicant response had clarified their commitments related to addressing the quality attributes of AMPs applicable to nonsafety-related structures and components subject to aging management and had adequately addressed the questions documented in RAI 2.1-6.

The audit team reviewed that the discussions of corrective actions contained in section B.0.3, "Corrective Actions, Confirmation Process and Administrative Controls," of Appendix B, "Aging Management Programs and Activities." The discussion stated that "in the case of significant conditions adverse to quality... corrective action is taken to lessen the likelihood of recurrence." This is not in agreement with the regulations contained in 10 CFR Part 50, Appendix B, section XVI, "Corrective Actions," which states, in part, "in the case of significant conditions adverse to quality, the measures shall assure that the cause of the condition is determined and corrective actions taken to preclude repetition." The applicant was requested to address this discrepancy. This request for information was documented as RAI 2.1-5.

The applicant responded by a letter to the NRC dated May 19, 2004, which stated that Appendix B, Section B.0.3 under the heading of "Corrective Actions" would be clarified as follows: "In the case of significant conditions adverse to quality, measures are implemented to ensure that the cause of the nonconformance is determined and that corrective action is taken to preclude repetition."

The staff concluded that the applicant's response had addressed the discrepancy between the definition of corrective action contained in Appendix B of the LRA and 10 CFR Part 50 be rewording that portion of Appendix B of the LRA to consistent with 10 CFR Part 50 and had adequately responded to the questions documented in RAI 2.1-7.

3.0.4.3 Conclusion

The audit team did not observe any exceptions to the use of the site Appendix B quality assurance program for the evaluation of the three quality assurance attributes. On the basis of this review, the staff finds that the quality assurance attributes are consistent with 10 CFR 54.21(a)(3). Therefore, the applicant's quality assurance attributes within the AMPs credited for license renewal are acceptable.

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3.1 Aging Management of Reactor Vessel, Internals, and Reactor Coolant System

This section of the SER documents the staff's review of the applicant's AMR results for the reactor vessel, internals, and reactor coolant system components and component groups associated with the following systems:

- reactor vessel and control element drive mechanism
- reactor vessel internals
- Class 1 piping, valves, and reactor coolant pumps
- pressurizer
- steam generators

3.1.1 Summary of Technical Information in the Application

In LRA Section 3.1, the applicant provided AMR results for the reactor vessel, internals, and reactor coolant system components and component groups. Table 3.1.1 of the LRA, "Summary of Aging Management Programs for the Reactor Coolant System in Chapter IV of NUREG-1801," provides a summary of the programs evaluated in the GALL Report for the RCS component groups.

3.1.2 Staff Evaluation

The staff reviewed LRA Section 3.1 to determine if the applicant provided sufficient information to demonstrate that the effects of aging for the reactor system components that are within the scope of license renewal and subject to an AMR will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff performed an audit to confirm the applicant's claim that certain identified AMRs were consistent with the GALL Report. The staff did not repeat its review of the matters described in the GALL Report. However, the staff did determine that the material presented in the LRA was applicable and that the applicant had identified the appropriate GALL AMPs. Section 3.0.3 of this SER documents the staff's evaluations of the AMPs. The ANO-2 Audit and Review Report documents the staff's audit findings, which are also summarized in Section 3.1.2.1 of this SER.

The staff also audited and reviewed those AMRs that are consistent with the GALL Report and for which further evaluation is recommended. The staff determined that the applicant's further evaluations were consistent with the acceptance criteria in Section 3.1.3.2 of the SRP-LR. Section 3.1.2.2 of the SER summarizes the staff's audit findings.

The staff conducted a technical review of the remaining AMRs that are not consistent with the GALL Report. The review included evaluating whether all plausible aging effects were identified and whether the aging effects listed were appropriate for the combination of materials and environments specified. Section 3.1.2.3 of the SER summarizes the staff's review findings.

Finally, the staff reviewed the AMP summary descriptions in the UFSAR Supplement to ensure that they provide an adequate description of the programs credited with managing or monitoring aging for the reactor vessel, internals, and reactor coolant system components and component groups.

Table 3.1-1 below provides a summary of the staff's evaluation of components, aging effects/mechanisms, and AMPs listed in LRA Section 3.1 that are addressed in the GALL Report.

Table 3.1-1 Staff Evaluation for Reactor Vessel, Internals, and Reactor Coolant System Components in the GALL Report

Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
Reactor coolant pressure boundary components (Item Number 3.1.1-1)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c))	TLAA-Metal Fatigue	Consistent with GALL, which recommends further evaluation (See Section 3.1.2.2.1)
Steam generator shell assembly (Item Number 3.1.1-2)	Loss of material due to pitting and crevice corrosion	Inservice inspection; water chemistry	Inservice Inspection (B.1.14), Water Chemistry Control (B.1.30)	Consistent with GALL, which recommends further evaluation (See Section 3.1.2.2.2)
Pressure vessel ferritic materials that have a neutron fluence greater than 10^{17} n/cm^2 (E>1 MeV) (Item Number 3.1.1-4)	Loss of fracture toughness due to neutron irradiation embrittlement	TLAA, evaluated in accordance with Appendix G of 10 CFR 50 and RG 1.99	TLAA-Reactor Vessel	Consistent with GALL, which recommends further evaluation (See Section 3.1.2.2.3)
Reactor vessel beltline shell and welds (Item Number 3.1.1-5)	Loss of fracture toughness due to neutron irradiation embrittlement	Reactor vessel surveillance	Reactor Vessel Integrity (B.1.21)	Consistent with GALL, which recommends further evaluation (See Section 3.1.2.2.3)
Westinghouse and Babcock & Wilcox (B&W) baffle/former bolts (Item Number 3.1.1-6)	Loss of fracture toughness due to neutron irradiation embrittlement and void swelling	Plant specific	Not Applicable to ANO-2. Core shroud plates are welded.	Consistent with GALL, which recommends further evaluation (See Section 3.1.2.2.3)
Small-bore reactor coolant system and connected systems piping (Item Number 3.1.1-7)	Crack initiation and growth due to stress corrosion cracking (SCC), intergrangular stress corrosion cracking (IGSCC), and thermal and mechanical loading	Inservice inspection; water chemistry; one-time inspection	Inservice Inspection (B.1.14), Water Chemistry Control (B.1.30)	Consistent with GALL, which recommends further evaluation (See Section 3.1.2.2.4)
Vessel Shell (Item Number 3.1.1-10)	Crack growth due to cyclic loading	TLAA	Not Applicable to ANO-2	Consistent with GALL, which recommends further evaluation (See Section 3.1.2.2.5)

Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
Reactor internals (Item Number 3.1.1-11)	Changes in dimension due to void swelling	Plant specific	RV Internal CASS (B.1.22), RV Internals Stainless Steel (B.1.23)	Consistent with GALL, which recommends further evaluation (See Section 3.1.2.2.6)
PWR core support pads, instrument tubes (bottom head penetrations), pressurizer spray heads, and nozzles for the steam generator instruments and drains (Item Number 3.1.1-12)	Crack initiation and growth due to SCC and/or primary water stress corrosion cracking (PWSCC)	Plant specific	Water Chemistry Control (B.1.30), Alloy 600 Aging Management (B.1.1), Inservice Inspection (B.1.14)	Consistent with GALL, which recommends further evaluation (See Section 3.1.2.2.7)
Cass austenitic stainless steel (CASS) reactor coolant system piping (Item Number 3.1.1-13)	Crack initiation and growth due to SCC	Plant specific	Water Chemistry Control (B.1.30), Inservice Inspection (B.1.14)	Consistent with GALL, which recommends further evaluation (See Section 3.1.2.2.7)
Pressurizer instrumentation penetrations and heater sheaths and sleeves made of Ni-alloys (Item Number 3.1.1-14)	Crack initiation and growth due to PWSCC	Inservice inspection; water chemistry	Inservice Inspection(B.1.14), Alloy 600 (B.1.1), Water Chemistry Control (B.1.30)	Consistent with GALL, which recommends further evaluation (See Section 3.1.2.2.7)
Westinghouse and B&W baffle former bolts (Item Number 3.1.1-15)	Crack initiation and growth due to SCC and irradiation-assisted stress corrosion cracking (IASCC)	Plant specific	Not Applicable to ANO-2	Consistent with GALL, which recommends further evaluation (See Section 3.1.2.2.8)
Westinghouse and B&W baffle former baffle bolts (Item Number 3.1.1-16)	Loss of preload due to stress relaxation	Plant specific	Not Applicable to ANO-2	Consistent with GALL, which recommends further evaluation (See Section 3.1.2.2.9)
Steam generator feedwater impingement plate and support (Item Number 3.1.1-17)	Loss of section thickness due to erosion	Plant specific	Not Applicable to ANO-2	Consistent with GALL, which recommends further evaluation (See Section 3.1.2.2.10)

Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
(Alloy 600) Steam generator tubes, repair sleeves, and plugs (Item Number 3.1.1-18)	Crack initiation and growth due to PWSCC outside diameter stress corrosion cracking (ODSCC), and/or intergranular attack (IGA); or Loss of material due to wastage and pitting corrosion, and fretting and wear; or deformation due to corrosion at tube support plate intersections	Steam generator tubing integrity; water chemistry	Steam Generator Integrity (B.1.25), Water Chemistry Control (B.1.30)	Consistent with GALL, which recommends further evaluation (See Section 3.1.2.2.11)
Tube support lattice bars made of carbon steel (Item Number 3.1.1-19)	Loss of section thickness due to flow-accelerated corrosion (FAC)	Plant specific	Not Applicable to ANO-2	Consistent with GALL, which recommends further evaluation (See Section 3.1.2.2.12)
Carbon steel tube support plate (Item Number 3.1.1-20)	Ligament cracking due to corrosion	Plant specific	Not Applicable to ANO-2	Consistent with GALL, which recommends further evaluation (See Section 3.1.2.2.13)
Steam generator feedwater inlet ring and supports (Item Number 3.1.1-21)	Loss of material due to flow accelerated corrosion	Combustion Engineering (CE) steam generator feedwater ring inspection	Not Applicable to ANO-2	Consistent with GALL, which recommends further evaluation (See Section 3.1.2.2.14)
Reactor vessel closure studs and stud assembly (Item Number 3.1.1-22)	Crack initiation and growth due to SCC and/or IGSCC	Reactor head closure studs	Inservice Inspection (B.1.14)	Consistent with GALL, which recommends no further evaluation (See Section 3.1.2.1)
CASS pump casing and valve body (Item Number 3.1.1-23)	Loss of fracture toughness due to thermal aging embrittlement	Inservice inspection	Inservice Inspection (B.1.14)	Consistent with GALL, which recommends no further evaluation (See Section 3.1.2.1)
CASS piping (Item Number 3.1.1-24)	Loss if fracture toughness due to thermal aging embrittlement	Thermal aging embrittlement of CASS	Inservice Inspection (B.1.14)	Consistent with GALL, which recommends no further evaluation (See Section 3.1.2.1)

Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
BWR piping and fittings; steam generator components (Item Number 3.1.1-25)	Wall thinning due to flow accelerated corrosion	Flow accelerated corrosion	Flow-Accelerated Corrosion (B.1.11), Water Chemistry Control (B.1.30)	Consistent with GALL, which recommends no further evaluation (See Section 3.1.2.1)
Reactor coolant pressure boundary (RCPB) valve closure bolting, manway and holding bolting, and closure bolting in high-pressure and high temperature systems (Item Number 3.1.1-26)	Loss of material due to wear; loss of preload due to stress relaxation; crack initiation and growth due to cyclic loading and/or SCC	Bolting Integrity	Inservice Inspection (B.1.14), Bolting and Torquing Activities (B.1.2)	Consistent with GALL, which recommends no further evaluation (See Section 3.1.2.1)
CRD nozzle (Item Number 3.1.1-35)	Crack initiation and growth due to PWSCC	Ni-alloy nozzles and penetrations; water chemistry	Inservice Inspection (B.1.14), Water Chemistry Control (B.1.30), RV Head Penetrations (B.1.20)	Consistent with GALL, which recommends no further evaluation (See Section 3.1.2.1)
Reactor vessel nozzles safe ends and CRD housing; reactor coolant system components (except CASS and bolting) (Item Number 3.1.1-36)	Crack initiation and growth due to cyclic loading and/or SCC, and PWSCC	Inservice inspection; water chemistry	Inservice Inspection (B.1.14), Water Chemistry Control (B.1.30).	Consistent with GALL, which recommends no further evaluation (See Section 3.1.2.1)
Reactor vessel internals CALL components (Item Number 3.1.1-37)	Loss of fracture toughness due to thermal aging, neutron irradiation embrittlement and void swelling	Thermal aging and neutron irradiation embrittlement	RV Internal CASS (B.1.22)	Consistent with GALL, which recommends no further evaluation (See Section 3.1.2.1)
External surfaces of carbon steel components in reactor coolant system pressure boundary (Item Number 3.1.1-38)	Loss of material due to boric acid corrosion	Boric acid corrosion	Boron Acid Corrosion Prevention (B.1.3)	Consistent with GALL, which recommends no further evaluation (See Section 3.1.2.1)

Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
Steam generator secondary manways and handholds (carbon steel) (Item Number 3.1.1-39)	Loss of material due to erosion	Inservice inspection	Not Applicable to ANO-2	Consistent with GALL, which recommends no further evaluation (See Section 3.1.2.3.5)
Reactor internals, reactor vessel closure studs, and core support pad (Item Number 3.1.1-40)	Loss of material due to wear	Inservice inspection	Inservice Inspection (B.1.14)	Consistent with GALL, which recommends no further evaluation (See Section 3.1.2.1)
Pressurizer integral support (Item Number 3.1.1-41)	Crack initiation and growth due to cyclic loading	Inservice inspection	Inservice Inspection (B.1.14)	Consistent with GALL, which recommends no further evaluation (See Section 3.1.2.1)
Upper and lower internals assembly (Westinghouse) (Item Number 3.1.1-42)	Loss of preload due to stress relaxation	Inservice inspection; loose part and/or neutron noise monitoring	RV Internals SS (B.1.23), Inservice Inspection (B.1.14)	Consistent with GALL, which recommends no further evaluation (See Section 3.1.2.1)
Reactor vessel internals in fuel zone region (except Westinghouse and B&W baffle former bolts) (Item Number 3.1.1-43)	Loss of fracture toughness due to neutron irradiation embrittlement and void swelling	PWR vessel internals; water chemistry	RV Internals SS (B.1.23)	Consistent with GALL, which recommends no further evaluation (See Section 3.1.2.1)
Steam generator upper and lower heads, tubesheets, and primary nozzles and safe ends (Item Number 3.1.1-44)	Crack initiation and growth due to SCC, PWSCC, and or IASCC	Inservice inspection; water chemistry	Water Chemistry Control (B.1.30), Alloy 600 (B.1.1), Inservice Inspection (B.1.14)	Consistent with GALL, which recommends no further evaluation (See Section 3.1.2.1)
Vessel Internals (except Westinghouse and B&W baffle former bolts) (Item Number 3.1.1-45)	Loss of fracture toughness due to neutron irradiation embrittlement and void swelling	PWR vessel internals; water chemistry	RV Internals CASS (B.1.23), RV Internals Stainless Steel (B.1.23), Water Chemistry Control (B.1.30), Inservice Inspection (B.1.14)	Consistent with GALL, which recommends no further evaluation (See Section 3.1.2.1)

Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
Reactor internals (B&W screws and bolts) (Item Number 3.1.1-46)	Loss of preload due to stress relaxation	Inservice inspection; loose part monitoring	Not Applicable to ANO-2	Consistent with GALL, which recommends no further evaluation (See Section 3.1.2.1)
Reactor vessel closure studs and stud assembly (Item Number 3.1.1-47)	Loss of material due to wear	Reactor head closure studs	Inservice Inspection (B.1.14)	Consistent with GALL, which recommends no further evaluation (See Section 3.1.2.1)
Reactor internals (Westinghouse upper and lower internal assemblies, CE bolts and tie rods) (Item Number 3.1.1-48)	Loss of preload due to stress relaxation	Inservice inspection; loose part monitoring	RV Internals Stainless Steel (B.1.23), Inservice Inspection (B.1.14)	Consistent with GALL, which recommends no further evaluation (See Section 3.1.2.1)

The staff's review of the ANO-2 RCS and associated components followed one of several approaches. One approach, documented in Section 3.1.2.1 of this SER, involves the staff's audit and review of the AMR results for components in the RCS that the applicant indicated are consistent with the GALL Report and do not require further evaluation. Another approach, documented in Section 3.1.2.2 of this SER, involves the staff's audit and review of the AMR results for components in the RCS that the applicant indicated are consistent with the GALL Report and for which further evaluation is recommended. A third approach, documented in Section 3.1.2.3 of this SER, involves the staff's technical review of the AMR results for components in the RCS that the applicant indicated are not consistent with the GALL Report or are not addressed in the GALL Report. Section 3.0.3 of this SER documents the staff's review of AMPs that are credited to manage or monitor aging effects of the RCS.

3.1.2.1 AMR Results That Are Consistent with the GALL Report

Summary of Technical Information in the Application

In Section 3.1.2.1 of the LRA, the applicant identified the materials, environments, and aging effects requiring management. The applicant identified the following programs that manage the aging effects related to the reactor vessel, internals, RCS, pressurizer, and SG components:

- Reactor Vessel Integrity Program
- Inservice Inspection Program
- Water Chemistry Control Program
- Boric Acid Corrosion Prevention Program
- Alloy 600 Aging Management Program
- Reactor Vessel Head Penetration Program
- Bolting and Torquing Activities Program

- Reactor Vessel Internals Cast Austenitic Stainless Steel Components Program
- Reactor Vessel Internals Stainless Steel Plates, Forgings, Welds, and Bolting Program
- Cast Austenitic Stainless Steel Evaluation Program
- Pressurizer Examinations Program
- Steam Generator Integrity Program
- Flow-Accelerated Corrosion Program

Staff Evaluation

In Tables 3.1.2-1 through 3.1.2-5 of the LRA, the applicant provided a summary of AMRs for the reactor vessel, internals, RCS, pressurizer, and SGs, and identified which AMRs it considered to be consistent with the GALL Report.

For component groups evaluated in the GALL Report for which the applicant claimed consistency with the GALL Report, and for which the GALL Report does not recommend further evaluation, the staff performed an audit and review to determine whether the plant-specific components contained in these GALL Report component groups are bounded by the GALL evaluation.

The applicant provided a note for each AMR line item. The notes describe how the information in the tables aligns with the information in the GALL Report. The staff audited those AMRs identified by notes A through E, which indicate that the AMR is consistent with the GALL Report.

Note A indicates that the AMR line item is consistent with the GALL Report for component, material, environment, and aging effect. In addition, the AMP is consistent with the AMP identified in the GALL Report. The staff audited these line items to determine consistency with the GALL Report and the validity of the AMR for the site-specific conditions.

Note B indicates that the AMR line item is consistent with the GALL Report for component, material, environment, and aging effect. In addition, the AMP takes some exceptions to the AMP identified in the GALL Report. The staff audited these line items to determine consistency with the GALL Report. The staff determined that it reviewed and accepted the identified exceptions to the GALL AMPs. The staff also determined whether the AMP identified by the applicant is consistent with the AMP identified in the GALL Report and whether the AMR is valid for the site-specific conditions.

Note C indicates that the component for the AMR line item is different, but consistent with the GALL Report for material, environment, and aging effect. In addition, the AMP is consistent with the AMP identified by the GALL Report. This note indicates that the applicant could not find a listing of some system components in the GALL Report. However, the applicant identified a different component in the GALL Report that has the same material, environment, aging effect, and AMP as the component under review. The staff audited these line items to determine consistency with the GALL Report. The staff also determined whether the AMR line item of the different component applies to the component under review and whether the AMR is valid for the site-specific conditions.

Note D indicates that the component for the AMR line item is different, but consistent with the GALL Report for material, environment, and aging effect. In addition, the AMP takes some

exceptions to the AMP identified in the GALL Report. The staff audited these line items to determine consistency with the GALL Report. The staff determined whether the AMR line item of the different component applies to the component under review. The staff determined that it reviewed and accepted the identified exceptions to the GALL AMPs. The staff also determined whether the AMP identified by the applicant is consistent with the AMP identified in the GALL Report and whether the AMR is valid for the site-specific conditions.

Note E indicates that the AMR line item is consistent with the GALL Report for material, environment, and aging effect, but a different AMP is credited. The staff audited these line items to determine consistency with the GALL Report. The staff also determined whether the identified AMP would manage the aging effect consistent with the AMP identified by the GALL Report and whether the AMR is valid for the site-specific conditions.

The staff conducted an audit and review of the information provided in the LRA and program bases documents, which are available at the applicant's engineering office. On the basis of its audit and review, the staff finds that the AMR results, which the applicant claimed to be consistent with the GALL Report, are in fact consistent with the AMRs in the GALL Report. Therefore, the staff finds that the applicant identified applicable aging effects that are appropriate for the combination of materials and environments listed.

On the basis of its audit and review, the staff concludes that the applicant has demonstrated that the effects of aging will be adequately managed so that the component intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

Conclusion

The staff has evaluated the applicant's claim of consistency with the GALL Report. The staff also has reviewed information pertaining to the applicant's consideration of recent operating experience and proposals for managing associated aging effects. On the basis of its review, the staff finds that the AMR results, which the applicant claimed to be consistent with the GALL Report, are in fact consistent with the AMRs in the GALL Report. Therefore, the staff finds that the applicant has demonstrated that the effects of aging for these components can be adequately managed so that their intended functions can be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.2 AMR Results That Are Consistent with the GALL Report, for Which Further Evaluation Is Recommended

Summary of Technical Information in the Application

In Section 3.1.2.2 of the LRA, the applicant provided further evaluation of aging management as recommended by the GALL Report for reactor vessel, internals, and RCS components. The applicant provided information concerning how it will manage the following aging effects:

- cumulative fatigue damage
- loss of material from pitting and crevice corrosion

- loss of fracture toughness as a resulting of neutron irradiation embrittlement
- crack initiation and growth caused by thermal and mechanical loading or SCC
- crack growth resulting from cyclic loading
- changes in dimension caused by void swelling
- crack initiation and growth resulting from SCC or PWSCC
- crack initiation and growth resulting from SCC or IASCC
- loss of preload caused by stress relaxation
- loss of section thickness as a result of erosion
- crack initiation and growth from PWSCC, ODSCC, or IGA or loss of material resulting from wastage and pitting corrosion or loss of section thickness caused by fretting and wear or denting from corrosion of carbon steel tube support plate
- loss of section thickness caused by flow-accelerated corrosion
- ligament cracking resulting from corrosion
- loss of material caused by flow-accelerated corrosion
- quality assurance for aging management of nonsafety-related components

Staff Evaluation

For component groups evaluated in the GALL Report for which the applicant claimed consistency with the GALL Report, and for which the GALL Report recommends further evaluation, the staff reviewed the applicant's evaluation to determine whether it adequately addressed the issues that were further evaluated. In addition, the staff reviewed the applicant's further evaluations against the criteria contained in Section 3.1.2.2 of the SRP-LR. The ANO-2 ANO-2 Audit and Review Report documents the details of the staff's onsite audit and review.

The GALL Report indicates that further evaluation should be performed for the aging effects described in the following sections of this SER.

3.1.2.2.1 Cumulative Fatigue Damage

As stated in the SRP-LR, fatigue is a TLAA, as defined in 10 CFR 54.3. TLAAs must be evaluated in accordance with 10 CFR 54.21(c)(1). Section 4.3 of this SER documents the staff's review of the applicant's evaluation of this TLAA. In performing this review, the staff followed the guidance in Section 4.3 of the SRP-LR.

3.1.2.2.2 Loss of Material from Pitting and Crevice Corrosion

In Section 3.1.2.2.2 of the LRA, the applicant addressed loss of material of SG assemblies due to pitting and crevice corrosion.

SRP-LR Section 3.1.2.2.2 states that loss of material due to pitting and crevice corrosion could occur in the SG shell assembly. The existing program relies on control of water chemistry to mitigate corrosion and ISI to detect loss of material. NRC IN 90-04, "Cracking of the Upper Shell-to-Transition Cone Girth Welds in Steam Generators," states that if general corrosion pitting of the shell exists, the existing program may not be sufficient. In that case, the GALL Report recommends augmented inspections to manage the aging effect.

The AMPs recommended by the GALL Report for managing the aging of SG assemblies due to pitting and crevice corrosion are ASME Section XI inservice inspection, Subsections IWB, IWC, and IWD (XI.M1) program to detect loss of material and the water chemistry (XI.M2) program to mitigate corrosion. The GALL Report recommends a plant-specific program to conduct augmented inspections.

The applicant credited the inservice inspection program (AMP B.1.14) and the primary and secondary water chemistry control program (AMP B.1.30.3) for managing loss of material due to pitting and crevice corrosion on the internal surfaces of the SG shell. The staff reviewed the inservice inspection program and the primary and secondary water chemistry control program and its evaluation of these programs is documented in Sections 3.0.3.3.5 and 3.0.3.1 of this SER, respectively.

The staff reviewed IN 90-04, which identifies the need to augment inspections beyond the requirements of ASME Section XI if general corrosion pitting of the SG shell is known to exist in order to differentiate isolated cracks from inherent geometric conditions. The applicant replaced its SGs in 2000. The staff reviewed operating experience which indicated that no pitting corrosion of the SG shell has been detected to date, and that water chemistry has been maintained for these new SGs per EPRI guidelines. The staff finds that the augmented inspections recommended by NRC IN 90-04, as referenced in the SRP-LR, do not currently apply to the the applicant's SGs.

Since pitting corrosion has not been detected on the SG shell since installation, the staff finds that augmented inspections are not required and that the current water chemistry control and inservice inspection programs are adequate to manage aging.

The staff finds that the applicant has demonstrated that the effect of aging for loss of material due to pitting and crevice corrosion will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation.

3.1.2.2.3 Loss of Fracture Toughness from Neutron Irradiation Embrittlement

In Section 3.1.2.2.3 of the LRA, the applicant addressed (1) loss of fracture toughness due to neutron irradiation embrittlement of the reactor vessel (RV) beltline materials, as managed using both a plant-specific AMP and the TLAAs on neutron irradiation embrittlement, and (2) loss of fracture toughness of RV internal components as a result of neutron irradiation embrittlement and void swelling.

Section 3.1.2.2.3 of the SRP-LR states that neutron irradiation embrittlement of RV beltline materials (i.e., with neutron fluences greater than $1.0x10^{17}$ n/cm^2 [E ≥ 1.0 MeV]) are to be treated as TLAAs, as defined in 10 CFR 54.3. Section 3.1.2.2.3 of the SRP-LR also states that loss of fracture toughness due to neutron irradiation embrittlement of the RV beltline materials is to be managed using a plant-specific AMP. In this case the plant-specific AMP is required to be the RV materials surveillance program that is mandated by 10 CFR Part 50, Appendix H. These RV materials surveillance programs monitor for neutron irradiation embrittlement by testing irradiated material test specimens that are representative of the materials located in the beltline region of the RV.

The plant-specific AMP recommended by the GALL Report for managing loss of fracture toughness/neutron irradiation embrittlement of the RV beltline materials is AMP XI.M31, "Reactor Vessel Surveillance," which complies with the requirements of 10 CFR Part 50, Appendices G and H, and 10 CFR Part 50.61.

The applicant stated that loss of fracture toughness due to neutron irradiation embrittlement of the ferritic RV materials meets the definition of a TLAA, as defined in 10 CFR 54.3. The applicant stated that this TLAA is described in Section 4.2 of the LRA. The staff evaluates the TLAA on neutron irradiation embrittlement in Section 4.2 of this SER.

The applicant stated in the LRA that loss of fracture toughness due to irradiation embrittlement of the reactor vessel beltline materials is managed by the Reactor Vessel Integrity Program (AMP B.1.21). This program is a plant-specific material surveillance program which monitors the effect of operational fluence levels on material test specimens that are contained in surveillance capsules positioned within the RV cavity. These surveillance capsule test specimens are representative of materials with the beltline region of the RV and are irradiated during power operations. These surveillance capsules are periodically withdrawn and the specimens within the capsules are tested and analyzed for fracture toughness and other material properties. The staff's evaluation of the Reactor Vessel Integrity Program is documented in Section 3.0.3.2.6 of this SER.

SRP-LR Section 3.1.2.2.3 states that loss of fracture toughness due to neutron irradiation embrittlement and void swelling could occur in Westinghouse and B&W baffle/former bolts. Section IV.B3 of GALL, Volume 2, identifies additional RV internal components that may be subject to loss of fracture toughness due to irradiation embrittlement and/or void swelling.

The applicant stated that this item is not applicable to ANO-2 because ANO-2 reactor vessel internals do not include baffle/former bolts. This does not address the potential for loss of fracture toughness due to neutron irradiation embrittlement and void swelling to occur in other RV internal components, as itemized in particular AMR line items in Section IV.B3 of GALL, Volume 2. The applicant, however, is participating in the EPRI MRP's industry initiative studies on RV internal components and has, as part of its Reactor Vessel Internals Program, committed to submit its program description for the ANO-2 RV internals, including the inspection plan, to the staff for review and approval. This commitment will address aging management of void swelling and neutron irradiation embrittlement of the RV internal components. The staff evaluation of the Reactor Vessel Internals Program is given in Section 3.0.3.1 of this SER.

3.1.2.2.4 Crack Initiation and Growth from Thermal and Mechanical Loading or Stress-Corrosion Cracking

In Section 3.1.2.2.4 of the LRA, the applicant addressed the potential crack initiation and growth due to thermal and mechanical loading or stress corrosion cracking (SCC) (including intergranular SCC) that could occur in small-bore RCS and connected system piping less than 4-inch nominal pipe size (NPS 4).

Section 3.1.2.2.4 of the SRP-LR states that the GALL Report recommends that a plant-specific destructive examination or a nondestructive examination (NDE) that permits inspection of the inside surfaces of the piping be conducted to ensure that cracking has not occurred and the component intended function will be maintained during the period of extended operation. The applicant should assess service-induced weld cracking is not occurring in small-bore piping less than NPS 4. A one-time inspection of a sample of locations is an acceptable method to ensure that the aging effect is not occurring and the component's intended function will be maintained during the period of extended operation. Per ASME Section XI, 1995 Edition, Examination Category B-J or B-F, small bore piping, defined as piping less than NPS 4, does not receive volumetric inspection.

The AMPs recommended by the GALL Report are XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," to detect loss of material and XI.M2, "Water Chemistry," to mitigate SCC. The GALL Report recommends GALL AMP XI.M32, "One-Time Inspection," as an acceptable verification method to ensure that cracking is not occurring in small bore piping.

The applicant credited the inservice inspection program (AMP B.1.14) and the primary and secondary water chemistry control program (AMP B.1.30.3) to mitigate cracking of reactor coolant piping. The staff's review of these programs is documented in Sections 3.0.3.3.5 and 3.0.3.1 of this SER, respectively.

To address the GALL Report recommendation of a plant-specific destructive examination or an NDE for inspection of inside surfaces of small bore piping, the applicant stated, in LRA Section 3.1.2.2.4 and Table 3.1.1-7, that it has implemented a risk-informed methodology at ANO-2 to select, for small bore RCS and connected systems piping, RCS piping welds for inspection. The applicant stated, in LRA Section 3.1.2.2.4, that the current inspection methods as described in the inservice inspection program appropriately address cracking of small bore piping systems less than four inch nominal pipe schedule (NPS 4) and greater than 1-inch (NPS 1). The staff finds that this methodology appropriately addresses cracking of small bore piping greater than NPS 1, and the risk-informed methodology adequately manages cracking initiation and growth aging mechanisms during the period of extended operation.

In Section 3.1.2.2.4 of the LRA, the applicant stated that, for NPS 1 RCS piping and smaller, the piping is austenitic stainless steel and is not within the scope of the risk-informed selection of piping welds for inspection. The applicant further stated that volumetric examinations of NPS 1 RCS piping and smaller are not effective, and the applicant performs system leakage testing, in accordance with ASME Section XI, as the preferred alternative to inspection of the inside surfaces of small bore piping NPS 1 and smaller.

In discussions with the applicant, the staff asked the applicant to clarify how the alternative of system leakage testing for NPS 1 RCS piping and smaller will adequately manage aging of small bore piping and to provide the technical basis for not including piping NPS 1 and smaller in the sample inspections from the risk-informed selections.

In its response, the applicant stated that operating experience has confirmed that leakage from NPS 1 and smaller piping is readily detected and corrected prior to loss of system function. Additionally, the applicant stated that it had implemented a program to investigate the potential for cracking of welded joints in RCS piping less than or equal to NPS 1 since the discovery of a cracked weld in an ANO-1 RCS drain line in 1989. Additionally, the applicant stated that the risk (based on probability and consequences) of failure of the 1-inch and smaller piping is less than the risk of failures of locations selected for inspection in the small-bore piping inspection program.

On the basis of the applicant's response and its review, the staff finds that visual inspection of NPS 1 and smaller RCS piping using systems leakage testing, in conjunction with volumetric examinations of NPS 1 to NPS 4 RCS piping of the same material and environment, adequately manages the effects of crack initiation and growth due to thermal and mechanical loading or stress corrosion cracking prior to loss of intended function. This approach is consistent with that for ANO-1 which was evaluated and approved by the staff in NUREG-1743, "Safety Evaluation Report Related to the License Renewal of Arkansas Nuclear One, Unit 1.

The staff finds that the applicant has demonstrated that crack initiation and growth due to thermal and mechanical loading or SCC on small-bore RCS and connected systems piping will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation.

3.1.2.2.5 Crack Growth from Cyclic Loading

As stated in the SRP-LR, fatigue is a time-limited aging analysis (TLAA) as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c))(1). The staff's review of the applicant's evaluation of this TLAA is documented in Section 4.3 of this SER. In performing this review, the staff followed the guidance in Section 4.3 of the SRP-LR.

3.1.2.2.6 Changes in Dimension from Void Swelling

In Section 3.1.2.2.6 of the LRA, the applicant addressed changes in dimension due to void swelling that could occur in reactor internal components.

Section 3.1.2.2.6 of the SRP-LR states that the GALL Report recommends that changes in dimension due to void swelling in reactor internal components be evaluated to ensure that this aging effect is adequately managed. The GALL Report recommends that a plant-specific AMP be evaluated to manage the effects of changes in dimension due to void swelling and the loss of fracture toughness associated with swelling.

The applicant stated that the void swelling of reactor vessel internals is managed by the reactor vessel internals cast austenitic stainless steel (CASS) program (AMP B.1.22) and the reactor vessel internals stainless steel plates, welds, forgings, and bolting program (AMP B.1.23) using supplemental examinations or component-specific evaluations. The applicant has committed to

further understanding of this aging effect through industry programs to provide additional bases for supplemental examinations or component-specific evaluations.

The staff evaluated the reactor vessel internals CASS program and the reactor vessel internals stainless steel plates, welds, forgings, and bolting program. The staff documented its results in Section 3.0.3.1 of this SER. These programs will be consistent with GALL AMPs XI.M13, "Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS)," and XI.M16, "PWR Vessel Internals," respectively.

The staff finds the applicant's approach for managing changes in dimension due to void swelling reasonable because the approach will be based on the guidelines developed by the ongoing industry activities related to void swelling. The applicant has committed to submitting both AMPs B.1.22 and B.1.23 to the staff for review and approval 24 months prior to the period of extended operation. To obtain NRC staff approval of its proposed inspection plans regarding CASS components and Reactor Vessel Internals prior to entering the period of extended operation for ANO-2, the applicant must submit a license amendment request. After the NRC staff's approval of the inspection plan, and future changes to the inspection plan will be evaluated in accordance with 10 CFR 50.59.

3.1.2.2.7 Crack Initiation and Growth from Stress-Corrosion Cracking or Primary Water Stress-Corrosion Cracking

The staff reviewed Section 3.1.2.2.7 of the LRA against the criteria in SRP-LR Section 3.1.2.2.7, which recommends plant-specific programs to address these aging mechanisms.

In Section 3.1.2.2.7 of the LRA, the applicant addressed (1) crack initiation and growth due to SCC and primary water stress corrosion cracking (PWSCC) in the surge nozzle thermal sleeve, safety injection nozzle thermal sleeve, charging inlet nozzle thermal sleeve, resistance temperature detector nozzles, pressure measurement nozzle, sampling nozzle, and partial nozzle replacement. Reactor vessel items included in this grouping are the lower shell and bottom head cladding, surveillance capsule holders, core stabilizing lugs, core stop and support lugs, and the flow baffle and skirt. Steam generator items included in this grouping are the tube plate cladding, channel head divider plate, and primary nozzle closure rings; (2) crack initiation and growth due to SCC in the pressurizer surge line piping and fittings fabricated of CASS; and (3) crack initiation and growth due to PWSCC in nickel-based alloy material such as the pressurizer instrumentation nozzles, heater sheaths and sleeves, and thermal sleeves. ANO-2 pressurizer components included in this grouping are the instrument nozzles, X-1 and T-4 heater penetration nozzles and plugs, original heater sheath, heater sleeve, and end plugs.

Section 3.1.2.2.7 of the SRP-LR states that

- Crack initiation and growth due to SCC and PWSCC could occur in core support pads (or core guide lugs), instrument tubes (bottom head penetrations), pressurizer spray heads, and nozzles for the SG instruments and drains. The GALL Report recommends further evaluation to ensure that these aging effects are adequately managed. The GALL Report recommends that a plant-specific AMP be evaluated because existing programs may not be capable of mitigating or detecting crack initiation and growth due to SCC.

- Crack initiation and growth due to SCC could occur in CASS RCS piping and fittings and pressurizer surge line nozzle. The GALL Report recommends further evaluation of piping that does not meet either the reactor water chemistry guidelines of TR-105714 or material guidelines of NUREG-0313.
- Crack initiation and growth due to PWSCC could occur in pressurizer instrumentation penetrations and heater sheaths and sleeves made of nickel alloys. The existing program relies on ASME Section XI ISI and on control of water chemistry to mitigate PWSCC. However, the existing program should be augmented to manage the effects of SCC on the intended function of nickel-alloy components. The GALL Report recommends that the applicant provide a plant-specific AMP or participate in industry programs to determine appropriate AMPs for PWSCC of the Alloy 182 weld.

The applicant credited the following plant-specific programs for each of the three SRP-LR criteria:

- Cracking of nickel-based alloy components due to PWSCC is managed by the Alloy 600 aging management program (AMP B.1.1) supplemented by the water chemistry control program and the inservice inspection program. Additionally, EPRI, through its material reliability program (MRP) and in conjunction with the PWR owners groups, is developing a strategic plan to manage and mitigate cracking of nickel-based alloy items. The applicant has stated that the guidance developed by the MRP will be used to identify critical locations for inspection and to augment existing ISI inspections, as appropriate. Since RCS pressure control using the pressurizer sprays is not an intended function of the pressurizer, the pressurizer spray assembly is not subject to aging management for ANO-2.
- Crack initiation and growth due to SCC at welded connections, including the pressurizer surge line and fittings, is managed by the water chemistry control program and the inservice inspection program.
- The programs credited for the management of PWSCC of these nickel-based alloy items are the Alloy 600 aging management program and the water chemistry control program, supplemented by the inservice inspection program. As described in Item 1 above, the applicant committed to participation in the Alloy 600 industry programs to identify critical locations for inspection and augment existing ISI, where appropriate.

The staff reviewed the plant-specific programs for these aging effects as follows:

- The staff's evaluation of the primary and secondary water chemistry control program (AMP B1.30.3) is documented in Section 3.0.3.1 of this SER.
- The staff's evaluation of the inservice inspection program (AMP B.1.14) is documented in Section 3.0.3.3.5 of this SER.

The staff's evaluation of the Alloy 600 aging management program (AMP B.1.1) is documented in Section 3.0.3.3.1 of this SER.

The staff finds that the applicant appropriately evaluated AMR results which address these aging mechanisms, as recommended in the GALL Report.

On the basis of its review, the staff finds that the applicant appropriately evaluated AMR results involving management of crack initiation and growth due to SCC or PWSCC, as recommended in the GALL Report.

3.1.2.2.8 Crack Initiation and Growth from Stress-Corrosion Cracking or Irradiation-Assisted Stress-Corrosion Cracking

In Section 3.1.2.2.8 of the LRA, the applicant stated that its reactor vessel internals do not include baffle/former bolts. The core shroud plates are joined in a welded configuration and that the discussion in this paragraph of NUREG-1800 is not applicable.

On the basis that the baffle/former bolts are not part of the design of reactor vessel internals, the staff finds that this aging effect is not applicable.

3.1.2.2.9 Loss of Preload from Stress Relaxation

In Section 3.1.2.2.9 of the LRA, the applicant stated that its reactor vessel internals do not include baffle/former bolts. The core shroud plates are joined in a welded configuration and that the discussion in this paragraph of NUREG-1800 is not applicable.

On the basis that the baffle/former bolts are not part of the design of reactor vessel internals, the staff finds that this aging effect is not applicable.

3.1.2.2.10 Loss of Section Thickness from Erosion

In Section 3.1.2.2.10 of the LRA, the applicant stated that its steam generators do not include impingement plates and that the discussion in this paragraph is not applicable.

Section 3.1.2.2.10 of the SRP-LR states that loss of section thickness due to erosion could occur in SG feedwater impingement plates and supports. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that this aging effect is adequately managed.

On the basis that impingement plates are not part of the steam generator design, the staff finds that this aging effect is not applicable.

3.1.2.2.11 Crack Initiation and Growth from Primary Water Stress-Corrosion Cracking, Outside-Diameter Stress-Corrosion Cracking, or Intergranular Attack or Loss of Material from Wastage and Pitting Corrosion, or Loss of Section Thickness from Fretting and Wear, or Denting from Corrosion of Carbon Steel Tube Support Plate

In Section 3.1.2.2.11 of the LRA, the applicant addressed crack initiation and growth due to PWSCC, outside diameter SCC (ODSCC,) or intergranular attack (IGA) or loss of material due to wastage and pitting corrosion or deformation due to corrosion that could occur in nickel-based alloy components of the SG tubes and plugs.

Section 3.1.2.11 of the SRP-LR states that crack initiation and growth due to PWSCC, ODSCC, or IGA or loss of material due to wastage and pitting corrosion or deformation due to corrosion could occur in Alloy 600 components of the SG tubes, repair sleeves and plugs. All PWR

licensees have committed voluntarily to a SG degradation management program described in NEI 97-06; these guidelines are currently under NRC staff review. The GALL Report recommends that an AMP based on the recommendations of staff-approved NEI 97-06 guidelines, or other alternate regulatory basis for SG degradation management, should be developed to ensure that this aging effect is adequately managed.

The SRP-LR also states that crack initiation and growth due to PWSCC, ODSCC or IGA or loss of material due to wastage and pitting corrosion or deformation due to corrosion could occur in nickel-based alloy components of the SG tubes and plugs.

To manage the effects of aging, the applicant credited the SG integrity program (AMP B.1.25) supplemented by the primary and secondary water chemistry control program (AMP B.1.30.3) and the inservice inspection program (AMP B.1.14).

The staff's evaluation of the SG integrity program is documented in Section 3.0.3.1 of this SER. The staff evaluated the primary and secondary water chemistry control and the inservice inspection program and its evaluations are documented in Sections 3.0.3.1 and 3.0.3.3.5 of this SER, respectively. For general and pitting corrosion and for the assessment of tube integrity and plugging or repair criteria of flawed tubes, the SG integrity program acceptance criteria are in accordance with NEI 97-06 guidelines.

On the basis of its review of the primary and secondary water chemistry control program and the inservice inspection program, the staff finds that the applicant appropriately evaluated AMR results involving plant-specific programs to address these aging mechanisms, as recommended in the GALL Report.

3.1.2.2.12 Loss of Section Thickness from Flow-Accelerated Corrosion

In Section 3.1.2.2.12 of the LRA, the applicant states that its steam generators do not include carbon steel tube support lattice bars. Therefore, loss of section thickness of these bars is not an applicable aging effect.

On the basis that carbon steel tube support lattice bars are not part of the SG design, the staff finds that this aging effect is not applicable.

3.1.2.2.13 Ligament Cracking from Corrosion

In Section 3.1.2.2.13 of the LRA, the applicant states that the steam generators have stainless steel tube support plates. Therefore, ligament cracking due to corrosion is not an applicable aging effect.

On the basis that carbon steel components are not part of the SG tube support plate design, the staff finds that this aging effect is not applicable to ANO-2.

3.1.2.2.14 Loss of Material from Flow-Accelerated Corrosion

In Section 3.1.2.2.14 of the LRA, the applicant stated that the discussion in this paragraph of NUREG-1800 is applicable to CE System 80 steam generators only, whereas it has Westinghouse Delta 109 steam generators.

On the basis that CE System 80 SGs are not part of the ANO-2 SGs design, the staff finds that ANO-2 components are not subject to this aging effect and that this aging effect is not applicable to ANO-2.

3.1.2.2.15 *Quality Assurance for Aging Management of Nonsafety-Related Components*

Section 3.0.4 of this SER provides a separate evaluation of the applicant's Quality Assurance Program.

Conclusion

On the basis of its review of component groups evaluated in the GALL Report for which the applicant has claimed consistency with GALL, and for which the GALL Report recommends further evaluation, the staff concludes that the applicant has adequately addressed the issues that were further evaluated. In addition, the staff reviewed the applicant's additional evaluations against the criteria contained in Section 3.1.2.2 of the SRP-LR. Because the applicant's AMR results are otherwise consistent with the GALL Report, the staff finds that the applicant has demonstrated that the effects of aging can be adequately managed so that the component intended functions can be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.3 AMR Results That Are Not Consistent With or Not Addressed in the GALL Report

Summary of Technical Information in the Application

In Tables 3.1.2-1 through 3.1.2-5 of the LRA, the applicant indicated, by means of notes F through J, that neither the identified component nor the material and environment combination is evaluated in the GALL Report. Thus, the applicant provided information concerning how the aging effect will be managed. LRA Tables 3.1.2-1 through 3.1.2-5 use the following notes to indicate the status of a specific component, environment, material, and/or aging effect in the GALL Report:

- Note F indicates that the material is not in the GALL Report for the identified component.
- Note G indicates that the environment is not in the GALL Report for the identified component and material.
- Note H indicates that the aging effect is not in the GALL Report for the identified component, material, and environment combination.
- Note I indicates that the aging effect in the GALL Report for the identified component, material, and environment combination is not applicable

- Note J indicates that the GALL Report does not evaluate either the identified component or the material and environment combination.

Staff Evaluation

For component type and material and environment combinations that are not evaluated in the GALL Report, the staff reviewed the applicant's evaluation to determine whether the applicant had demonstrated that the effects of aging will be adequately managed so that the component intended functions will be maintained consistent with the CLB during the period of extended operation.

The following sections discuss the staff's evaluation.

3.1.2.3.1 Reactor Vessel and Control Element Drive Mechanism Pressure Boundary

Summary of Technical Information in the Application

In Section 3.1.2.1.1 of the LRA, the applicant identified the materials, environments, and aging effects requiring management. The applicant identified the following programs that manage the aging effects for the reactor vessel (RV) and control element drive mechanism (CEDM) and associated pressure boundary components:

- Reactor Vessel Integrity Program
- Inservice Inspection Program
- Water Chemistry Control Program
- Boric Acid Corrosion Prevention Program
- Alloy 600 Aging Management Program
- Reactor Vessel Head Penetration Program
- Bolting and Torquing Activities Program

Table 2.3.1-1 of the LRA lists the following individual system components within the scope of license renewal and subject to an AMR:

- closure head lifting lugs
- closure studs, nuts, and washers
- core stabilizing lugs
- core stop lugs
- flow skirt
- grayloc clamp
- grayloc clamp studs
- grayloc clamp nuts
- in-core instrumentation drive nuts
- in-core instrumentation spacer sleeves
- reactor vessel support pads
- shear lugs
- surveillance capsule holders
- CEDM motor housing
- CEDM upper pressure housing

- CEDM ball seal housing
- CEDM upper pressure housing upper fitting
- CEDM motor housing upper and lower end fittings
- CEDM upper pressure housing lower fitting
- CEDM nozzle
- in-core instrumentation nozzle tubes
- CEDM steel ball
- in-core instrumentation flange adapter/seal plate
- reactor vessel vent pipe
- reactor vessel vent pipe flange
- bottom head (torus and dome)
- upper shell
- closure head dome (torus and dome)
- closure head flange
- intermediate shell
- lower shell
- primary inlet nozzles
- primary outlet nozzles
- primary inlet nozzle safe ends
- primary outlet nozzle safe ends
- vessel flange

In Table 3.1.2-1 of the LRA, the applicant provided a summary of AMRs for the RV and CEDM and associated pressure boundary components and identified which AMRs it considered to be consistent with the GALL Report.

Staff Evaluation

The staff reviewed Table 3.1.2-1 of the LRA, which summarizes the results of AMR evaluations in the SRP-LR for the RV and CEDM pressure boundary component groups.

Aging Effects

Aging Management of Low-Alloy Steel RV Components In External Air Environments. The applicant identified that low-alloy steel components that are exposed to an external air environment are subject to cracking, cracking (fatigue), loss of material, and loss of mechanical closure integrity.

The applicant did not identify in Section 3.1 of the LRA, or in Table 3.1.2-1, which aging mechanisms could lead to cracking in low-alloy steel components exposed to an external air environment. The staff forwarded RAIs on the RV internals and the RCS by letter dated June 11, 2004. In RAI 3.1.2.1-1, the staff requested additional information on the applicant's AMRs for managing cracking in low-alloy steel components that are exposed to an external air environment, particularly because aging management strategies for license renewal are somewhat dependent on the specific types of aging mechanisms that can induce age-related degradation, rather than on the general classification of the aging effect.

In response to RAI 3.1.2.1-1, the applicant stated that the low-alloy steel items that are susceptible to external cracking are limited to fasteners (e.g., RV closure studs) and the exterior

attachments to vessels. Fasteners are not intentionally exposed to water or steam, but exposure may result from gasket leaks. If leakage is combined with contaminant species, such as sulfides or chlorides, an aggressive environment that can promote SCC may result. The applicant concluded that for the RCS components fabricated from low-alloy steel, including exterior attachments to vessels and fasteners, cracking at welded joints (i.e., initiation by fatigue and growth of preservice flaws at welded joints caused by service loadings) is considered an aging effect requiring management for the period of extended operation. The Inservice Inspection Program manages cracking. The TLAA for metal fatigue manages cracking of low-alloy steel RV components by fatigue. The staff finds the applicant's response acceptable and considers this issue closed.

In RAI 3.1.2.1-4, the staff requested a clarification on where Section 3.1 of the LRA or Table 3.1.2-1 considers the boric acid corrosion aging mechanism. The RAI noted that the clarification should include which component types, materials, environments, AERMs, and AMPs are associated with this aging mechanism.

In response to RAI 3.1.2.1-4, the applicant stated that in LRA Section 3.1 and Tables 3.1.2-1 and 3.1.2-3, boric acid corrosion is an applicable mechanism for loss of material for carbon steel and low-alloy steel components with an external air environment. Carbon and low-alloy steel components (including all bolting materials, piping and fittings, RCP driver mounts, and vessels and support skirts) of the RCS that are exposed to an external air environment are susceptible to loss of material by boric acid corrosion. The Boric Acid Corrosion Prevention Program, discussed in Section B.1.3 of the LRA, manages this aging effect. The staff finds the applicant's response acceptable and considers this issue closed.

Low-alloy steel clad with stainless steel and nickel-based alloy exposed to an internal environment of treated water is subject to loss of material, cracking, and cracking (fatigue). Low-alloy steel clad with stainless steel and nickel-based alloy exposed to an external environment of air is subject to loss of material. Low-alloy steel clad with stainless steel exposed to an internal environment of treated water is subject to loss of material, cracking, cracking (fatigue), and a reduction in fracture toughness. Low-alloy steel clad with stainless steel exposed to an external environment of air is subject to loss of material.

Aging Management of Nickel-Based Alloy Components in an Internal Borated Treated Water Environment. The applicant identified that nickel-based alloy components that are exposed to an internal environment of treated, borated water are subject to cracking, cracking (fatigue), and loss of material.

The applicant did not identify in Section 3.1 of the LRA, or in Table 3.1.2-1, which aging mechanisms could lead to loss of material in nickel-based alloy components. In RAI 3.1.2.1-2, the staff requested additional information on the applicant's AMRs for managing loss of material for nickel-based alloy components that are exposed to an internal environment of treated, borated water.

In response to RAI 3.1.2.1-2, the applicant stated that loss of material can be induced by crevice and pitting corrosion or by wear in nickel-based alloy components. If RCS fluid chemistry is not rigorously controlled, the concentration of system fluid contaminants could lead to loss of material from pitting or crevice corrosion of the nickel-based material. The applicant addresses this aging effect by maintaining rigorous control of RCS chemistry under the Water

Chemistry Control Program. Loss of material from wear has the potential to occur between the nickel-based alloy core-stabilizing lugs and the core barrel. While there has been no operating experience at ANO-2 showing that wear has occurred in this location, relative motion occurring from the handling of the vessel internals or thermal expansion during heatup and cooldown could lead to loss of material as a result of wear. The Inservice Inspection Program manages loss of material from wear. Finally, the nickel-based alloy SG U-tubes are subject to loss of material by sliding wear at tube support locations. Loss of material by sliding wear occurs when forces imposed on the tubes by the secondary fluid cause high-frequency vibration of the tubes and tube support structures. The Steam Generator Integrity Program manages loss of tube material from wear. The staff finds the applicant's response acceptable and considers this issue closed.

Aging Management of Stainless Steel Components. The applicant identified that stainless steel components that are exposed to an external air environment are subject to cracking (fatigue) and loss of mechanical closure. The applicant identified that stainless steel components that are exposed to an internal environment of treated, borated water are subject to cracking, cracking (fatigue), and loss of material.

The applicant did not identify in Section 3.1 of the LRA, or in Table 3.1.2-1, which aging mechanisms could lead to loss of material in stainless steel components. In RAI 3.1.2.1-3, the staff requested additional information on the applicant's AMRs for managing loss of material in stainless steel components that are exposed to an internal environment of treated, borated water.

In response to RAI 3.1.2.1-3, the applicant stated that loss of material can be induced by crevice and pitting corrosion of stainless steel in treated, borated water, if the RCS fluid chemistry is not rigorously controlled. The applicant addresses this aging effect by maintaining rigorous control of RCS chemistry under the Water Chemistry Control Program.

The applicant also stated that various stainless steel components at ANO-2 (e.g., the RV internals) are subject to flow-induced vibration during plant operation and differential thermal expansion and contraction movement during plant heatup, cooldown, and changes in power operating cycles. Flow -induced vibration and thermal expansion can cause repetitive relative movement between stainless steel interfacing and mating surfaces. This relative movement between the interfacing and mating surfaces may result in surface wear. The Inservice Inspection Program manages loss of material from the wear of these interfacing and mating surfaces. The staff finds the applicant's response acceptable and considers this issue closed.

On the basis of its review of the information provided in the LRA, and the additional information included in the applicant's response to its RAIs, the staff finds the aging effects of the above RV and CEDM pressure boundary component types are consistent with industry experience for these combinations of materials and environments. The staff did not identify any missing aging effects. Therefore, the staff finds that the applicant has identified the appropriate aging effects for the materials and environments associated with the above components in the RV and CEDM pressure boundary.

Aging Management Programs

After evaluating the applicant's identification of aging effects for each of the above components, the staff evaluated the AMPs to determine if they are appropriate for managing the identified aging effects. The staff also determined that the UFSAR Supplement contains an adequate description of the program. LRA Table 3.1.2-1 identifies the following AMPs for managing the aging effects described above for the RV and CEDM pressure boundary:

- Alloy 600 Aging Management Program
- Boric Acid Corrosion Prevention Program
- Reactor Vessel Head Penetration Program*
- Reactor Vessel Integrity Program
- Inservice Inspection Program*
- System Walkdown Program*
- Bolting and Torquing Activities Program
- Water Chemistry Control Program*

The NRC staff reviewed those AMPs identified with an asterisk (*) during an onsite audit. Sections 3.0.3.3.1, 3.0.3..2.1, 3.0.3.2.6, and 3.0.3.3.2 of this SER document the staff's review of remaining AMPs.

The applicant proposed to manage loss of material for the following stainless steel, nickel-based alloy, and low alloy steel clad with stainless steel and nickel-based alloy component types of the reactor vessel and CEDM pressure boundary system - core stop lugs, flow skirt, and surveillance capsule holders; penetrations for the CEDM motor housing, CEDM upper pressure housing, CEDM ball seal housing, CEDM upper pressure housing upper fitting, CEDM motor housing upper and lower end fittings, CEDM upper pressure housing lower fitting, CEDM nozzle, ICI nozzle tubes, ICI flange adapter/seal plate, reactor vessel vent pipe, and reactor vessel vent pipe flange; reactor vessel shell and nozzles for the bottom head (torus and dome), upper shell, closure head dome (torus and dome), intermediate shell, lower shell, and primary inlet/outlet nozzle safe ends - exposed internally to treated, borated water using the primary and secondary water chemistry control program (AMP B.1.30.3). The staff's evaluation of the primary and secondary water chemistry control program is documented in Section 3.0.3.1 of this SER. The staff concludes that the primary and secondary water chemistry control program credited by the applicant for this line item is adequate.

For each of these same component and material combinations in Table 3.1.2-1, the applicant is also managing cracking using the water chemistry control program (AMP B.1.14), inservice inspection - inservice inspection program (AMP B.1.14), and a plant-specific program such as Alloy 600 aging management program (AMP B.1.1). The staff's evaluation of the inservice inspection - inservice inspection - IWB, IWC, IWD, and IWF program is documented in Section 3.0.3.3.5 of this SER. The staff concludes that the inservice inspection - inservice inspection program credited by the applicant for this line item is adequate. The staff reviewed the Alloy 600 aging management program and its evaluation is documented in Section 3.0.3.3.1 of this SER. On the basis of the above discussion, the staff finds that the applicant manages cracking in a manner consistent with the GALL Report.

On the basis that management of cracking of stainless steel, nickel-based alloy and low alloy steel clad with stainless steel is being managed by the water chemistry control and inservice

inspection programs, and the effects of pitting and crevice corrosion on stainless steel and nickel-based alloy components are not significant in chemically treated, borated water, the staff finds that management of loss of material using water chemistry control is adequate.

In the case of the stainless steel CEDM motor housing, upper-pressure housing and fitting, and ball seal housing as well as the CEDM nickel-alloy fittings, the staff asked the applicant to justify application of this position under the low-flow conditions that are expected. The staff reviewed a report (ML003748904) of maintenance activities that documented site-specific experience. This included a record of the visual inspection of materials in the same environment that had been operated under virtually identical conditions without observable loss of material, confirming the effectiveness of a water chemistry control program for management of this aging effect.

On the basis of industry and plant-specific operating experience, and the fact that the applicant manages the cracking aging effect of these same components, materials, and environment combinations using water chemistry control and inservice inspection programs, the staff finds that the use of a plant-specific water chemistry program to manage loss of material for stainless steel and nickel-based alloy components exposed to treated, borated water is acceptable.

The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the component intended functions will be maintained consistent with the CLB during the period of extended operation.

Conclusion

On the basis of its audit and review, the staff concludes that the applicant has adequately identified the aging effects, and the AMPs credited for managing the aging effects, for the RV and CEDM pressure boundary components so that the component intended functions can be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable UFSAR Supplement program summary descriptions and concludes that the UFSAR Supplement adequately describes the AMPs credited with managing aging in these components, as required by 10 CFR 54.21(d).

As stated in the staff's evaluation of the Reactor Vessel Integrity Program, Appendix H to 10 CFR Part 50 requires licensees to submit any proposed changes to their withdrawal schedules to the NRC for review and approval. As mentioned, Table 5.2-12 of the ANO-2 LRA contains a statement that says NRC approval is required, per Appendix H to 10 CFR Part 50, before changing removal intervals. To ensure that this requirement will carry forward after the ANO-2 operating license has been renewed, the staff will impose the following license condition in the renewed license for ANO-2 that requires Entergy to submit any further changes to the surveillance capsule withdrawal schedule for NRC review and approval:

> All capsules in the reactor vessel that are removed and tested must meet the test procedures and reporting requirements of ASTM E 185-82 to the extent practicable for the configuration of the specimens in the capsule. Any changes to the capsule withdrawal schedule, including spare capsules, must be approved by the NRC prior to implementation. All capsules placed in storage must be

maintained for future insertion. Any changes to storage requirements must be approved by the NRC.

3.1.2.3.2 Reactor Vessel Internals

Summary of Technical Information in the Application

In Section 3.1.2.1.2 of the LRA, the applicant identified the materials, environments, and AERMs. The applicant identified the following programs that manage the AERMs for the RV internals and associated pressure boundary components:

- Reactor Vessel Internals Cast Austenitic Stainless Steel (CASS) Components Programs
- Reactor Vessel Internals Stainless Steel Plates, Forgings, Welds, and Bolting Program
- Water Chemistry Control Program
- Inservice Inspection Program

Table 2.3.1-2 of the LRA lists individual system components within the scope of license renewal and subject to an AMR.

- control element assembly (CEA) instrument tube
- CEA shroud adapter
- CEA shroud support
- positioning plate
- CEA shroud extension shaft guides, cylinders, and bases
- CEA shroud base
- CEA shroud flow channel
- CEA shroud flow channel cap
- CEA shroud shaft retention pin
- CEA shroud retention block
- external spanner nut
- internal spanner nut
- CEA shroud fasteners
- CEA shroud flow channel extension
- CEA shroud tubes
- core shroud plates
- plates
- ribs[2]
- intermediate plates
- core shroud guide lugs
- core support barrel (CSB) alignment keys
- CSB assembly dowel pin

[2] Note: The core shroud assembly ribs are the vertical members located along the outer surface (away from the core) of the core shroud assembly. The ribs provide structural stiffness and support to the core shroud assembly, and are welded in place to provide the appropriate intended function of the core shroud assembly.

- CSB lifting bolt insert
- CSB lower flange
- CSB lug
- CSB nozzle
- CSB cylinder
- CSB upper flange
- CSB cylinder
- CSB upper flange (continued)
- guide tubes
- in-core instrumentation thimble support plate assembly
- in-core instrumentation support plate, grid, lifting support, lifting plate, column, plates, funnel
- pad, ring, nipple, hex bolt, spacer
- threaded rod, hex jam nut, thimble support nut, cap screws
- bottom plate
- bottom plate manhole cover
- cylinder
- core support column
- core support plate
- insert pins
- support beam
- support beam flange
- fuel assembly alignment plate (FAP)
- FAP guide lug inserts
- holddown ring
- upper guide structure (UGS) support plate
- UGS cylinder
- UGS grid plate
- UGS flange
- UGS sleeve
- UGS lifting bolt insert
- UGS alignment keys
- UGS dowel pins

In Table 3.1.2-2 of the LRA, the applicant provided a summary of AMRs for the RV internals and associated pressure boundary components and identified which AMRs it considered to be consistent with the GALL Report.

Staff Evaluation

The staff reviewed Table 3.1.2-2 of the LRA, which summarized the results of AMR evaluations in the SRP-LR for the RV internals component groups.

The staff reviewed the AMR of the RV internals component-material-environment-AERM combinations that are not addressed in the GALL Report or required additional staff review. These combinations are identified by notes F through J, or plant-specific notes, in LRA Table 3.1.2-2. The NRC staff reviewed those portions of the RV internals that are covered by the GALL Report (specified by notes A through E in Table 3.1.2-2) during an onsite audit. The staff

also reviewed the applicable UFSAR Supplements for the AMPs to ensure that the program descriptions are adequate.

Aging Effects

Aging Management of RV Internals Components Fabricated from Stainless Steel Materials, Including Cast Austenitic Stainless Steel (CASS). The applicant identified that stainless steel RV internal components (including CASS) that are exposed to an internal environment of treated, borated water are subject to loss of material, reduction in fracture toughness, cracking, cracking (fatigue), and changes in dimension. The applicant identified that loss of mechanical closure integrity is an additional aging effect requiring management for fastened stainless steel RV internals components.

The applicant did not identify in Section 3.1 of the LRA, or in Table 3.1.2-1, which aging mechanisms could lead to loss of material and cracking in CASS RV internals components. In RAI 3.1.2.2-1, the staff requested additional information on the applicant's AMRs for managing loss of material and cracking in CASS components that are exposed to an internal environment of treated, borated water.

In response to RAI 3.1.2.2-1, the applicant stated that if the RCS fluid chemistry is not rigorously controlled, the concentration of system fluid contaminants could lead to loss of material from pitting and crevice corrosion of CASS material.

The applicant concluded that CASS material may be susceptible to SCC or to IGA, if exposed to high concentrations of contaminants in the treated, borated water. In addition, IASCC is a degradation mechanism for CASS reactor internals items where materials become more susceptible to SCC with increasing exposure to neutron irradiation. The relatively benign environment of the RCS fluid, which incorporates hydrogen overpressure to reduce oxygen levels, reduces the potential for IASCC degradation of the RV internal components made from CASS materials. Loss of material from pitting or crevice corrosion is also a potential aging mechanism for CASS reactor internal components in the treated, borated water environment.

The only CASS item in the RV internals is the CEA shroud tube. The applicant credited the Inservice Inspection Program and the Water Chemistry Control Program with the management of loss of material and cracking in the CEA shroud tube. The applicant also credited the Reactor Vessel Internals Cast Austenitic Stainless Steel Components Program with the management of cracking, as well as loss of fracture toughness from thermal aging, in the CASS CEA shroud tube. These programs are consistent with industry wide programs for managing loss of material and cracking for CASS RV internal components and are therefore acceptable programs to credit for aging management. The staff considers this issue closed. Sections 3.0.3.3.4 and 3.0.3.2.3 of this SER document the staff's evaluation of the ability of the Inservice Inspection Program and the Water Chemistry Control Program to manage loss of material and cracking in the CASS CEA shroud tube. The staff evaluates the ability of the Reactor Vessel Internals Cast Austenitic Stainless Steel Components Program (which is discussed in LRA Section B.1.22) to manage loss of fracture toughness and cracking in the CASS CEA shroud tube later in this section of the SER.

On the basis of its review of the information provided in the LRA, the staff finds that the aging effects for the above RV internals component types are consistent with industry experience for

these combinations of materials and environments. The staff did not identify any omitted aging effects. Therefore, the staff finds that the applicant has identified the appropriate aging effects for the materials and environments associated with the above components in the RV internals.

Aging Management Programs

After evaluating the applicant's identification of aging effects for each of the above components, the staff evaluated the AMPs to determine if they are appropriate for managing the identified aging effects. The staff also determined that the UFSAR Supplement contains an adequate description of the program.

LRA Table 3.1.2-2 identifies the following AMPs for managing the aging effects described above for the RV internals:

- Inservice Inspection Program
- Water Chemistry Control Program*
- Reactor Vessel Internals Cast Austenitic Stainless Steel Components Program*
- Reactor Vessel Internals Stainless Steel Plates, Forgings, Welds, and Bolting Program*

The NRC staff reviewed those AMPs identified by an asterisk (*) during an onsite audit. Section 3.0.3.3.4 of this SER present the review of the Inservice Inspection Program.

The applicant proposed to use the Primary and Secondary Water Chemistry Control Program (AMP B.1.30.3) to manage loss of material for the following stainless steel component types of the RV internals system exposed internally to treated, borated water—CEA shroud assembly components, such as CEA instrument tube, CEA shroud adapter, CEA shroud support, positioning plate, CEA shroud flow channel extension, and core shroud tube; core shroud assembly components, such as core shroud plates, plates, ribs, intermediate plates, and core shroud guide lugs; and in-core instrumentation components, such as guide tubes, in-core instrumentation thimble support plate assembly, in-core instrumentation support plate, grid, lifting support, lifting plate, columns, plates, funnel, pad, ring, nipple, hex bolt, spacer, threaded rod, hex jam nut, thimble support nut, and cap screws. Section 3.0.3.1 of this SER documents the staff's evaluation of the Primary and Secondary Water Chemistry Control Program. The staff concludes that the Primary and Secondary Water Chemistry Control Program credited by the applicant for this line item is adequate.

For each of these same component and material combinations in LRA Table 3.1.2-2, the applicant is also managing cracking using the Water Chemistry Control Program, the Inservice Inspection—Inservice Inspection Program (AMP B.1.14), and a plant-specific program, such as the Reactor Internals Stainless Steel Program. Section 3.0.3.3.5 of this SER documents the staff's evaluation of the Inservice Inspection—Inservice Inspection Program (ASME Code Subsections IWB, IWC, IWD, and IWF). The staff concludes that the Primary and Secondary Water Chemistry Control Program credited by the applicant for this line item is adequate. Section 3.0.3.1 of this SER documents the staff's review of the Reactor Vessel Internals Stainless Steel Plates, Forgings, Welds, and Bolting Program (AMP B.1.23). On the basis of the above discussion, the staff finds that the applicant manages cracking in a manner consistent with the GALL Report.

Because the applicant is managing cracking of stainless steel by the Water Chemistry Control and the Inservice Inspection Programs, and the effects of pitting and crevice corrosion on stainless steel components are not significant in chemically treated, borated water, the staff finds that management of loss of material using water chemistry control is adequate.

The GALL Report recommends a loose parts monitoring program to manage loss of mechanical closure integrity for CEA shroud extension shaft guides, cylinders, and bases; shroud base; shroud flow channel; shroud flow channel cap; shroud shaft retention pin; shroud retention block; spanner nuts; shroud fasteners; guide tubes; in-core instrumentation thimble support plate assembly; in-core instrumentation support plate, grid, lifting support, lifting plate, column, plates, and funnel; pad, ring, nipple, hex bolt, spacer; threaded rod, hex jam nut, thimble support nut, cap screws, and RV internals.

The applicant proposed to manage this aging effect using the Reactor Vessel Internals Stainless Steel Plates, Forgings, Welds, and Bolting Program (AMP B.1.23) and the Inservice Inspection—Inservice Inspection Program (AMP B.1.14). Sections 3.0.3.1 and 3.0.3.3.5 of this SER, respectively, document the staff's review of these programs. The staff concludes that the Reactor Vessel Internals Stainless Steel Plates, Forgings, Welds, and Bolting Program and the Inservice Inspection—Inservice Inspection Program credited by the applicant for this line item are adequate.

On the basis that the Reactor Vessel Internals Programs detect aging effects before the loss of mechanical integrity of these components, the staff finds that their use, in lieu of a loose parts monitoring program, is acceptable. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the component intended functions will be maintained consistent with the CLB during the period of extended operation.

Conclusion

On the basis of its audit and review, the staff concludes that the applicant has adequately identified the aging effects, and the AMPs credited for managing the aging effects, for the reactor vessel internal components so that the component intended functions can be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable UFSAR Supplement program descriptions and concludes that the UFSAR Supplement adequately describes the AMPs credited with managing aging in these components, as required by 10 CFR 54.21(d).

3.1.2.3.3 Class 1 Piping, Valves, and Reactor Coolant Pumps

Summary of Technical Information in the Application

In Section 3.1.2.1.3 of the LRA, the applicant identified the materials, environments, and aging effects requiring management. The applicant identified the following programs that manage the AERMs for the Class 1 piping, valves, and RCP and the associated pressure boundary components:

- Water Chemistry Control

- Inservice Inspection
- Cast Austenitic Stainless Steel
- Boric Acid Corrosion Prevention
- Alloy 600 Aging Management
- Bolting and Torquing Activities

Table 2.3.1-3 of the LRA lists the following individual system components within the scope of license renewal and subject to an AMR:

- charging inlet nozzle
- safety injection nozzle
- surge line nozzle
- charging inlet nozzle safe end
- drain nozzle safe end
- letdown nozzle safe ends
- pressure measurement nozzle safe end
- sampling nozzle safe end
- charging inlet nozzle thermal sleeve
- safety injection nozzle thermal sleeve
- surge line thermal sleeve
- ASME Code Class 1 boundary orifices
- ASME Code Class 1 pipe and fittings NPS less than 4 inches
- ASME Code Class 1 pipe NPS greater than or equal to 4 inches
- ASME Code Class 1 fittings
- cold-leg piping and elbows
- hot-leg pipe and elbows
- drain nozzles
- letdown nozzles
- shutdown cooling outlet nozzle
- spray nozzle
- pressure measurement nozzle
- replacement pressure nozzle
- sampling nozzle
- RCP safe ends
- resistance temperature device (RTD) nozzles
- safety injection nozzle safe end
- shutdown cooling outlet nozzle safe end
- surge nozzle safe end
- stainless steel bolting
- surge line pipe and elbows
- surge line piping: RTD and sampling nozzles
- carbon/alloy steel bolting
- valve bodies and bonnets
- ASME Code Class 2 and 3 closure bolting
- ASME Code Class 2 and 3 fittings
- ASME Code Class 2 and 3 pipe
- ASME Code Class 2 and 3 valve bodies and bonnets
- tubing
- RCP casing

- RCP cover
- RCP cover studs
- RCP cover nuts
- RCP driver mount assembly
- RCP thermal barrier heat exchanger inner coil
- RCP thermal barrier heat exchanger outer coil
- RCP thermal barrier bored hole heat exchanger

In Table 3.1.2-3 of the LRA, the applicant provided a summary of the AMRs for the Class 1 piping, valves, and RCP and the associated pressure boundary components and identified which AMRs it considered to be consistent with the GALL Report.

Staff Evaluation

The staff reviewed Table 3.1.2-3 of the LRA, which summarizes the results of the AMR evaluations in the SRP-LR for the Class 1 piping, valves, and RCP component groups. The staff finds that the programs proposed for management of the aging effects for the component types in this system are consistent with the GALL Report.

The NRC staff reviewed the AMR of the ASME Code Class 1 piping, valves, and RCP component-material-environment-AERM combinations that are not addressed in the GALL Report, or required additional staff review. Table 3.1.2-3 identifies these combinations by notes F through J, or plant-specific notes. The NRC staff reviewed those portions of the ASME Class 1 piping, valves, and RCPs that are covered by the GALL Report (specified by notes A through E in Table 3.1.2-3) during an onsite audit. The staff also reviewed the applicable UFSAR Supplements for the AMPs to ensure that the program descriptions are adequate.

Aging Effects

Aging Management of ASME Code Class 1 Piping, Valve, Pump and Fitting Components Fabricated from Carbon Steel and Low-Alloy Steel Materials. The surfaces of carbon steel components that are clad internally with stainless steel and are exposed to an internal environment of treated, borated water are subject to the aging effects of loss of material, cracking, and cracking (fatigue). The surfaces of carbon steel components, including carbon steel components with internal stainless steel cladding, that are exposed to an external air environment are subject to the aging effects of loss of material and cracking (fatigue).

Low-alloy steel components exposed to an external environment of air are subject to the aging effects of loss of material, cracking, cracking (fatigue), and, for low-alloy steel bolting components, loss of mechanical closure integrity.

Aging Management of ASME Code Class 1 Piping, Valve, Pump and Fitting Components Fabricated from Nickel-Based Alloy and Stainless Steel Materials, Including CASS. The applicant identified that nickel-based alloy components that are exposed to an internal environment of treated, borated water are subject to the aging effects of loss of material, cracking, and cracking (fatigue).

The applicant identified that stainless steel components that are exposed to an internal environment of treated, borated water are subject to the aging effects of loss of material,

cracking, and cracking (fatigue). The applicant identified that stainless steel exposed to an external environment of air is subject to the aging effects of cracking, cracking (fatigue), reduction in fracture toughness (17-4PH [precipitation-hardened] material only), and loss of mechanical closure integrity. The applicant identified that stainless steel components exposed to an external environment of treated water are subject to the aging effects of loss of material, cracking, and cracking (fatigue).

The applicant identified that CASS components that are exposed to an internal environment of treated, borated water or a treated water external environment are subject to the aging effects of loss of material, cracking, cracking (fatigue), and reduction in fracture toughness.

In LRA Table 3.1.2-3, page 3.1-79, the applicant identified treated water as the external environment for the RCP thermal barrier heat exchanger inner coil. In addition, on page 3.1-80, the applicant identified treated water as the internal environment for the RCP thermal barrier heat exchanger outer coil and bored-hole heat exchanger. The aging effects of loss of material, cracking, and fatigue require aging management.

The AMPs identified to manage these aging effects are the Inservice Inspection Program and the Time-Limited Aging Analysis (TLAA)—Metal Fatigue. The applicant's Auxiliary Systems Water Chemistry Control Program, described in Section B.1.30.1, identifies its purpose as managing loss of material, cracking, and fouling of components exposed to treated water systems. The applicant has identified similar components of the same material which are exposed to the same environment as being managed by a water chemistry AMP and referenced concurrence with the GALL Report, Section VII.C2.2-a. In RAI 3.1.2-3.1, the staff requested that the applicant provide justification for excluding an AMP to manage the water chemistry of the treated water environment, as applicable to these components.

In response to RAI 3.1.2-3.1, the applicant stated that the treated water identified in the ANO-2 LRA which supplies cooling to the RCP thermal barrier heat exchangers is part of the ANO-2 component cooling water (CCW) system. The chemistry controls for this system are not sufficiently rigorous to control the contaminants which could potentially lead to loss of material and cracking in the RCP thermal barriers. Therefore, the Component Cooling Water Chemistry Control Program is not credited as managing these aging effects. The applicant concluded that the Inservice Inspection Program will manage these aging effects such that corrective action may be taken before a loss of the component intended function. The staff finds the applicant's response acceptable and considers this issue closed.

On the basis of its review of the information provided in the LRA, and the additional information included in the applicant's response to the above RAI, the staff finds the aging effects for the ASME Code Class 1 piping, valves, and RCPs are consistent with industry experience for these combinations of materials and environments. The staff did not identify any omitted aging effects. Therefore, the staff finds that the applicant has identified the appropriate aging effects for the materials and environments associated with the above components in the ASME Code Class 1 piping, valves, and RCPs.

Aging Management Programs

After evaluating the applicant's identification of aging effects for each of the above components, the staff evaluated the AMPs to determine if they are appropriate for managing the identified

aging effects. The staff also determined that the UFSAR Supplement contains an adequate description of the program.

LRA Table 3.1.2-3 identifies the following AMPs for managing the aging effects described above for the ASME Code Class 1 piping, valves, and RCPs:

- Inservice Inspection Program
- Water Chemistry Control Program*
- Alloy 600 Aging Management Program
- Boric Acid Corrosion Prevention Program
- System Walkdown Program*
- Cast Austenitic Stainless Steel (CASS) Evaluation Program*
- Bolting and Torquing Activities Program

The NRC staff reviewed those AMPs identified by an asterisk (*) during an onsite audit. Sections 3.0.3.3.4, 3.0.3.3.1, 3.0.3.2.1, and 3.0.3.3.2 of this SER document the staff's evaluation of remaining AMPs.

On the basis of its review of the information provided in the LRA, the staff finds that the applicant has identified appropriate AMPs for managing the aging effects of the Class 1 piping, valves, and RCP component types. In addition, the staff finds the program descriptions in the UFSAR Supplement acceptable.

Conclusion

On the basis of its review, the staff concludes that the applicant has adequately identified the aging effects and the AMPs credited for managing them for the ASME Code Class 1 piping, valves, and RCPs so that there is assurance that the component intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable UFSAR Supplement program descriptions and concludes that the UFSAR Supplement adequately describes the AMPs credited with managing aging in these components, as required by 10 CFR 54.21(d).

3.1.2.3.4 Pressurizer

Summary of Technical Information in the Application

In Section 3.1.2.1.4 of the LRA, the applicant identified the materials, environments, and aging effects requiring management. The applicant identified the following programs that manage the AERMs for the pressurizer and associated pressure boundary components:

- Water Chemistry Control Program
- Pressurizer Examinations Program
- Inservice Inspection Program
- Boric Acid Corrosion Prevention Program
- Alloy 600 Aging Management Program
- Bolting and Torquing Activities Program

- Cast Austenitic Stainless Steel (CASS) Evaluation Program

Table 2.3.1-4 of the LRA lists the following individual system components within the scope of license renewal and subject to an AMR:

- heater end plug
- heater sheaths
- heater sleeves
- heater support channel
- heater support plates
- heater support plate brackets
- heater support plate bracket bolts
- lower head
- lower shell
- upper shell
- upper head
- lower level nozzle
- manway cover bolts/studs
- manway cover plate
- manway forging
- manway gasket retainer plate
- mechanical nozzle seal assembly (MNSA) bolting (studs, nuts, and washers)
- MNSA compression collar
- MNSA upper flanges
- pressure measurement nozzle
- upper-level nozzle
- vent nozzle
- temperature nozzle
- pressure measurement nozzle safe end
- upper/lower-level nozzle safe end
- vent nozzle safe end
- temperature nozzle safe end
- safety valve nozzle
- spray nozzle
- surge nozzle
- safety valve nozzle flange
- spray nozzle safe end
- spray nozzle thermal sleeve
- support skirt
- surge nozzle safe end

In Table 3.1.2-4 of the LRA, the applicant provided a summary of AMRs for the pressurizer and associated pressure boundary components and identified which AMRs it considered to be consistent with the GALL Report.

Staff Evaluation

The staff reviewed Table 3.1.2-4 of the LRA, which summarizes the results of AMR evaluations in the SRP-LR for the pressurizer component groups.

The technical staff reviewed the AMR of component-material-environment-AERM combinations for the pressurizer components that are not addressed in the GALL Report, or required additional staff reviews. These combinations are identified by notes F through J, or plant-specific notes, in LRA Table 3.1.2-4. The NRC staff reviewed those portions of the pressurizer that are covered by the GALL Report (specified by notes A through E in Table 3.1.2-4) during an onsite audit. The staff determined that the applicant identified all applicable AERMs and credited the appropriate AMPs for managing them. The staff also reviewed the applicable UFSAR Supplements for the AMPs to ensure that the program descriptions are adequate.

Aging Effects

Aging Management of Pressurizer Components Fabricated from Nickel-Based Alloy or Stainless Steel Materials, Including CASS. The applicant identified that nickel-based alloy components (including the cladding of low-alloy steel pressurizer components that are clad internally with nickel-based alloy materials) that are exposed to an internal environment of treated, borated water are subject to the aging effects of loss of material, cracking, and cracking (fatigue).

The applicant identified that stainless steel components (including CASS and the cladding of low-alloy steel pressurizer components that are clad internally with stainless steel materials) that are exposed to an internal environment of treated, borated water are subject to the aging effects of loss of material, cracking, and cracking (fatigue). The applicant identified that for CASS components that are exposed to an internal environment of treated, borated water, reduction in fracture toughness as a result of thermal aging is an additional aging effect requiring management. The applicant identified that stainless steel components that are exposed to an external environment of air are subject to the aging effects of cracking and cracking (fatigue).

The applicant did not identify in Section 3.1 of the LRA, or in Table 3.1.2-4, which aging mechanisms could lead to cracking in stainless steel components. In RAI 3.1.2.4-2, the staff requested that the applicant provide additional information on the AMRs for managing cracking in stainless steel components that are exposed to an external air environment. In response to RAI 3.1.2.4-2, the applicant stated that generally, stainless steel exposed to an external air environment is not susceptible to aging effects requiring management. Insulation material used for RCS components has low soluble chloride and other halide content to minimize the possibility of SCC of stainless steel components. However, stainless steel items, such as flange and valve bolting, in air are subject to cracking, as indicated in Table 3.1.2-3 on page 3.1-68 of the LRA. Stainless steel fasteners are not intentionally exposed to water or steam, but exposure may result from gasket leaks. If leakage is combined with contaminant species, such as sulfides or chlorides, an aggressive environment that can promote SCC may result. Therefore, the applicant concluded that cracking of stainless steel flange and valve bolting is considered an AERM for the period of extended operation. Even though cracking is not expected, the Inservice Inspection Program is credited to confirm the absence of cracking

resulting from SCC. The staff finds the applicant's response acceptable and considers this issue closed.

The applicant also did not identify in Section 3.1 of the LRA, or in Table 3.1.2-4, which aging mechanisms could lead to loss of material and cracking in the cladding of low-alloy steel pressurizer components that are clad either with stainless steel or nickel-based alloy and are exposed to an internal environment of treated, borated water. In RAI 3.1.2.4-3, the staff requested that the applicant provide additional information on the AMRs for managing loss of material and cracking in the cladding materials that are exposed to an internal environment of treated, borated water.

In response to RAI 3.1.2.4-3, the applicant stated that the stainless steel cladding and nickel-based alloy cladding are susceptible to cracking by SCC and PWSCC, respectively. The applicant also stated that both the stainless steel cladding and nickel-based alloy cladding are susceptible to loss of material by crevice or pitting corrosion, which is consistent with the applicant's responses to RAIs 3.1.2.1-2 and 3.1.2.1-3 on corresponding materials in the ANO-2 RV.

In RAI 3.1.2.4-5, the staff inquired as to how the applicant was managing cracking, and specifically PWSCC, in the nickel-based penetration nozzles of the ANO-2 pressurizer and any associated nickel-based alloy weld materials. In response to RAI 3.1.2.4-5, the applicant stated that nickel-based alloy penetrations associated with the ANO-2 pressurizer include pressure measurement, vent, level, and temperature nozzles; heater penetration nozzles and plugs; and Alloy 82/182 welds. All of these nickel-based alloy items are exposed to treated, borated water and are susceptible to PWSCC. A combination of the Inservice Inspection Program, the Water Chemistry Control Program, and the Alloy 600 Aging Management Program manages this aging effect. Sections B.1.14, B.1.30, and B.1.1, respectively, of the ANO-2 LRA discuss the details of these programs, including scope, frequency, technique, acceptance criteria, and the technical basis for future examinations. These programs represent industry norms for managing PWSCC of nickel-based alloy base-metal and weld components and are acceptable programs to credit for management of PWSCC in the nickel-based alloy base-metal and weld components in the ANO-2 pressurizer system. The staff finds the applicant's response acceptable and considers this issue closed. Sections 3.0.3.3.4 and 3.0.3.2.8 of this SER, respectively, present the staff's evaluation of the Inservice Inspection Program and the Water Chemistry Control Program. Section 3.0.3.3.1 of this SER presents the staff's evaluation of the Alloy 600 Aging Management Program.

Aging Management in Carbon Steel and Low-Alloy Steel Pressurizer Components. The applicant identified that carbon steel components exposed to an external environment of air are subject to the aging effects of loss of material, cracking, and cracking (fatigue).

The applicant identified that low-alloy steel components exposed to an external environment of air are subject to the aging effects of loss of material, cracking, cracking (fatigue), and loss of mechanical closure integrity. The applicant also identified that unclad low-alloy steel (lower

head only) exposed to an external environment of treated, borated water experiences the aging effect of loss of material.[3]

The applicant did not identify in Section 3.1 of the LRA, or in Table 3.1.2-4, which aging mechanisms could lead to cracking in carbon steel components. In RAI 3.1.2.4-1, the staff requested that the applicant provide additional information on the AMRs for managing cracking in carbon steel components that are exposed to an external air environment.

In response to RAI 3.1.2.4-1, the applicant referred to its response to RAI 3.1.2.1-1, which concluded that for the RCS components fabricated from low-alloy steel, including exterior attachments to vessels, cracking at welded joints (initiated by fatigue and growth of preservice flaws at welded joints caused by service loadings) is considered an aging effect requiring management for the period of extended operation. Thus, to respond to RAI 3.1.2.4-1, the applicant extended the applicability of the discussion in its response to RAI 3.1.2.1-1 (as it pertains to cracking of low-alloy steel RCS components) to the surfaces of carbon steel pressurizer components that are exposed to the external air environment and considers cracking to be an AERM for the carbon steel pressurizer components.

For the underlying ferritic steel in the pressurizer (i.e., the low-alloy steel heads and shells in the pressurizer), service loadings may result in the growth of preservice flaws or initiation and growth of service-induced flaws. Cracking at the welded low-alloy steel joints is considered an aging effect requiring management for the period of extended operation. The applicant concluded that growth of fabrication flaws caused by service loads is the bases for the ASME Code, Section XI, inspections, as documented in EPRI NP-1406-SR, "Nondestructive Examination Acceptance Standards." The applicant credited the Inservice Inspection Program to manage this particular aging effect. Because the applicant is managing this aging effect through application of the recommendations of the EPRI standard, as implemented through the Inservice Inspection Program, the staff concludes that the applicant's response is acceptable and considers this issue closed.

The applicant credits the Inservice Inspection Program to manage cracking of the carbon steel and low-alloy steel pressurizer components in general. The applicant also credits the TLAA on metal fatigue of ASME Code Class 1 components to manage cracking that is induced by thermal fatigue of these components. These programs are consistent with industry norms for managing cracking in these components. The staff finds the applicant's response acceptable and considers this issue closed.

Table 3.1.2-4, page 3.1-84, identifies the pressurizer lower head, lower shell, upper shell, and upper head as component types. The applicant identified the aging effect of loss of material, and specified that it is applicable to the unclad low-alloy steel of the lower head only. In RAI 3.1.2.4-4, the staff requested the applicant to justify limiting the aging effect to only the lower head, since many components of the pressurizer are susceptible to boric acid corrosion in a

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[3] The environment discussed in this sentence refers to the environmental condition that results either from installation of a mechanical nozzle seal assembly repair method or half-nozzle replacement design. These repair/replacement methods leave the underlying ferritic (low-alloy steel) materials adjoined to the repaired pressurizer nozzle exposed to the reactor coolant (i.e., treated, borated water environment). The applicant considers this to be an external environment.

treated, borated water environment and would require the aging effect of loss of material to be managed.

In response to RAI 3.1.2.4-4, the applicant stated that Table 3.1.2-4, page 3.1-84, identifies loss of material as an aging effect requiring management for unclad lower vessel head low-alloy steel exposed to treated, borated water. The applicable locations for this table entry are heater nozzle penetrations that have been repaired. An Alloy 600 nozzle may contain a through-wall flaw that exposes the underlying ferritic steel to treated, borated water. These locations are susceptible to loss of material caused by exposure to treated, borated water. In addition, LRA Table 3.1.2-4 identifies loss of material for low-alloy steel pressurizer items exposed to air with the potential for leaking borated water. Table 3.1.2-4, page 3.1-83, of the LRA, identifies the ANO-2 pressurizer upper head, upper shell, lower head, and lower shell identified as susceptible to loss of material caused by boric acid corrosion in an external air environment. The staff finds the applicant's response acceptable and considers this issue closed.

In Table 3.1.2-4 of the ANO-2 LRA, the applicant identified pressurizer component types, the aging effects requiring management, and the AMPs that will manage these aging effects. Recent operational experience at both domestic and foreign facilities (i.e., Palo Verde, Units 2 and 3; Millstone, Unit 2; Waterford, Unit 3; and Tsuruga, Unit 2 in Japan) has shown that leakage of pressurizer penetrations from PWSCC is an aging effect that requires management. In light of the recent industry experience, and the limited scope of the Pressurizer Examinations Program, the staff requested, in RAI 3.1.2.4-5, that the applicant discuss how it will manage the aging effect of PWSCC for the pressurizer penetrations during the period of extended operation.

With regard to the installation of MNSAs as alternative repair methods, the NRC staff believes that, should an applicant decide to keep an MNSA in service beyond the period for which temporary approval has already been granted, the applicant must provide a justification which supports the approval of the MNSA, either as a temporary repair for the facility or as a permanent repair for the facility. The applicant's justification should be submitted against the alternative ISI provisions of 10 CFR 50.55a(a)(3), and should include an analysis of the pressure boundary component to which the MNSA is attached, an assessment of all age-related mechanisms that may be applicable to the MNSA design and to all ferritic and nickel-based alloy components to which the MNSA installation is applicable, and a proposed alternative ISI program for the MNSA, which is to be maintained for the NRC-approved period (i.e., for the period of approval if the MNSA is approved as a temporary repair, or throughout the licensed life of the facility if the MNSA is approved as a permanent repair for the facility). The applicant should submit its justification to the NRC for review and approval no later than 1 year before the expiration of its existing temporary repair approval period.

On the basis of its review of the information provided in the LRA, and the additional information included in the applicant's response to the above RAIs, the staff finds that the aging effects of the pressurizer component types are consistent with industry experience for these combinations of materials and environments. The staff did not identify any omitted aging effects. Therefore, the staff finds that the applicant has identified the appropriate aging effects for the materials and environments associated with the components in the pressurizer.

Aging Management Programs

After evaluating the applicant's identification of aging effects for each of the above components, the staff evaluated the AMPs to determine if they are appropriate for managing the identified aging effects. The staff also determined that the UFSAR Supplement contains an adequate description of the program.

LRA Table 3.1.2-4 identifies the following AMPs for managing the aging effects described above for the pressurizer:

- Inservice Inspection Program
- Water Chemistry Control Program
- Pressurizer Examinations Program*
- Alloy 600 Aging Management Program
- Boric Acid Corrosion Prevention Program
- System Walkdown Program*
- Cast Austenitic Stainless Steel (CASS) Evaluation Program*
- Bolting and Torquing Activities Program

The NRC staff reviewed those AMPs identified with an asterisk (*) during an onsite audit. Sections 3.0.3.3.4, 3.0.3.2.8, 3.0.3.3.1, 3.0.3.2.1, and 3.0.3.3.2 of this SER document the staff's review of remaining AMPs.

During the review, the staff noted that the applicant had not credited the Inservice Inspection Program (AMP B.1.14) for managing the cracking of pressurizer safe ends. The staff requested the applicant to correct this discrepancy.

By letter dated March 24, 2004, the applicant committed to using the Inservice Inspection Program to manage cracking of the pressurizer safe ends. This is now consistent with the GALL Report and acceptable to the staff.

For loss of material from the nickel-alloy pressurizer heater support plates and support brackets exposed to treated, borated water, the applicant credited the Water Chemistry Control Program. Section 3.0.3.1 of this SER documents the staff's evaluation of this AMP. The staff concludes that the Water Chemistry Control Program credited by the applicant for this line item is adequate.

On the basis of industry operating experience with this material and use of a water chemistry control program consistent with the GALL Report, the staff found this acceptable.

On the basis of its review of the information provided in the LRA, the staff finds that the applicant has identified appropriate the AMPs for managing the aging effects of the pressurizer component types.

Conclusion

On the basis of its audit and review, the staff concludes that the applicant has adequately identified the aging effects, and the AMPs credited for managing the aging effects, for the pressurizer components so that the component intended functions can be maintained