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Subject: Arkansas Nuclear One - Unit 1
Docket No. 50-313
License No. DPR-51
License Renewal Application RAIs (TAC No. MA8054)

Gentlemen:

By letters dated April 17, 2000 (1CNA040004), May 5, 2000 (1CNA050002), June 1, 2000 (1CNA060002), June 9, 2000 (1CNA060004), and June 23, 2000 (1CNA060006), the NRC requested additional information concerning the Arkansas Nuclear One, Unit 1 (ANO-1) License Renewal Application (LRA). Attached are the responses to the requests for additional information (RAIs) pertaining to the Section 3.0 of the ANO-1 LRA. Should you have any further questions, please contact me.

Very truly yours,

Jimmy D. Vandergrift
Director, Nuclear Safety Assurance

JDV/nbm
Attachment

A082

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Request for Additional Information Regarding ANO-1 LRA Section 3.0, dated April 17, 2000 (1CNA040004), May 5, 2000 (1CNA050002), June 1, 2000 (1CNA060002), June 9, 2000 (1CNA060004), and June 23, 2000 (1CNA060006)

3.3.1.1-1 In Section 4.6, "Chemistry Control," of the LRA, the following chemistry monitoring programs are addressed: Primary Chemistry Monitoring Program, Secondary Chemistry Monitoring Program, Auxiliary Systems Chemistry Monitoring, Diesel Fuel Monitoring Program, and Service Water Chemical Control Program. For each program, provide the following information:

(a) For each subprogram in the Chemistry Control Program, please provide the major parameters; e. g., contaminants and oxygen, sampled and analyzed, the acceptable ranges and the frequency of sampling.

Each subprogram in the Chemistry Control Program is based on widely adopted industry guidelines and industry operating experience. They are current licensing basis programs that have been demonstrated effective. These programs will be continued during the period of extended operation. Specific information on each of these programs is provided below.

1. Primary Chemistry Monitoring Program - This program is based on the Electric Power Research Institute (EPRI) "Pressurized Water Reactor (PWR) Primary Water Chemistry Guidelines" (Rev. 4), as well as the B&W Water Chemistry Manual, and other industry guidelines. These guidelines were based on technical input and concurrence from U.S. nuclear steam supply system vendors, utility personnel, and water treatment experts, and lessons learned from many years of operating experience. They include detailed descriptions of water chemistry parameters to be monitored, the criteria for determining acceptable values, frequency, etc. Typical parameters that are monitored include dissolved oxygen, chloride, fluoride, sulfate, silica, and pH. Sample frequency and analysis may be daily, weekly, monthly, quarterly, etc. depending on the parameter involved, the plant operating mode, and the results of the previous sample analysis. Action levels and guidelines are established for each parameter monitored. The ANO-1 program complies with the EPRI guidelines and is documented in site procedures.

2. Secondary Chemistry Monitoring Program - This program is based on the EPRI "PWR Secondary Water Chemistry Guidelines"

(TR-102134, Rev. 4), as well as other industry guidelines. These guidelines are based on input from U.S. nuclear steam supply system vendors, utility personnel, and water treatment experts. They include parameters for chemistry control, sampling and analysis frequencies, and acceptance criteria. Typical parameters that are monitored include dissolved oxygen, sodium, chloride, sulfate and silica. Sample frequency and analysis may be continuous, daily, weekly, during planned outages, etc. depending on the parameter involved, the plant operating mode, and the results of the previous sample analysis. Action levels and guidelines are established for each parameter monitored. The ANO-1 program complies with the EPRI guidelines and is documented in site procedures.

3. Auxiliary Systems Chemistry Monitoring Program - This program is based on equipment vendor specifications, chemical vendor recommendations, technical manuals, industry standards, and operating experience. Guidelines utilized include the B&W Water Chemistry Manual, EPRI guidelines, as well as vendor and other industry guidelines. Typical parameters that are monitored include pH, iron, copper, hardness, nitrate and biological count. Sample frequency and analysis may be weekly, monthly, quarterly, etc. depending on the parameter involved, the plant operating mode, and the results of the previous sample analysis. Action levels and guidelines are established for each parameter monitored. The ANO-1 program complies with industry and vendor guidelines, has been modified based on operating experience, and is documented in site procedures.

4. Diesel Fuel Monitoring Program - This program is based on various industry accepted guidelines such as ASTM D975, "Standard Specification for Diesel Fuel Oils," military specifications, other ASTM standards, and EPRI, "Storage and Handling of Fuel Oil for Standby Diesel Generator Systems." Typical parameters that are monitored include water and sediment, particulates, biological count and sulfur. The program includes quarterly sampling and analysis of fuel oil and guidelines for action based on the sample results. The ANO-1 program complies with industry and vendor guidelines, has been adjusted based on operating experience, and is documented in site procedures.

5. Service Water Chemical Control Program – This program is a combination of the Service Water Integrity Program, the Secondary Chemistry Monitoring Program, and a series of operating procedures that control the chemical injection systems. This

program is based on various industry-accepted guidelines such as EPRI guidelines, ANO specific experience, and compliance with NRC Generic Letter 89-13. Typical parameters that are monitored include corrosion rates, oxidants, and corrosion inhibitor. This program includes daily sampling and analysis of the service water and guidelines for action based on the sample results. The ANO-1 service water system was recently the subject of an NRC Safety System Engineering Inspection. Additional information on the adequacy of the Service Water Integrity Program can be found in Entergy Operations' response to Inspection Report 99-09, dated February 17, 2000 (0CAN020001).

(b) Describe how the sampling locations address stagnant or low flow areas in the systems that rely on chemistry monitoring. Include in this discussion, whether samples are taken at stagnant locations, the uses of representative samples from one location to represent several stagnant locations and the criteria used to select the representative sample, and/or the use of other means to manage aging for these areas, such as visual inspections.

Most systems included in the chemistry monitoring programs are active and do not have stagnant areas. For portions of systems that are inactive or stagnant that require sampling, provisions have been made to circulate fluids prior to sampling based on accepted industry practices. Plant procedures direct periodic sampling and analysis of stagnant service water system components to ensure adequate distribution of biocides and corrosion inhibitors. In addition, visual inspections are performed on components and systems that are opened for maintenance activities. Abnormal or unexpected aging effects that could impact the intended function of a system, structure, or component would be evaluated and addressed in accordance with the corrective action program.

(c) Although each of these programs are based on EPRI guidelines, deviations from the recommendations in the guidelines may occur based on ANO-specific and/or industry experience. Please provide a more detailed description of how deviations from the guidelines demonstrate the effectiveness of these programs in managing the aging effects referenced. Focus on the last five to seven years and discuss any applicable aging not prevented by the AMPs in question. Include in this discussion, changes to the program and the reason for the changes.

The ANO chemistry monitoring programs are subject to continuous oversight to incorporate relevant industry and ANO-specific operating experience. As industry guidelines, such as EPRI, are revised or new guidelines are published, Entergy Operations reviews the new information and determines whether changes to existing site procedures and practices are needed. In addition, the corrective action program at ANO is used to document and evaluate abnormal or unexpected aging effects that could impact the intended function of a system, structure, or component to determine if changes in chemistry control programs are needed. For example, in 1996, a diesel fuel oil sample revealed out-of-specification water and sediment in the fuel oil. The corrective action program was used to document and evaluate the problem. The findings were that condensation and small amounts of water delivered in transports had been building up in the bottom of the fuel oil bulk storage tank over time. Prior to this event, sampling was not done from the bottom of the bulk storage tank. The corrective action taken included the addition of sampling from the bottom of the bulk storage tank and implementation of quarterly draining of any accumulated water from the bottom of the tank.

Another example is the service water chemical control program. Monitoring, by use of side stream corrosion racks and bio-boxes, is performed to assist with evaluation of the program effectiveness. Significant changes in this program in the 1990s, such as implementation of continuous biocide treatment of the system, have been effective in controlling biofouling in piping and equipment. This has been confirmed in recent component inspections and thermal performance testing of heat exchangers as discussed in the February 17, 2000, correspondence to the NRC (0CAN020001). Entergy Operations has reduced the corrosion of the service water components by improving chemical treatments and will continue to evaluate improved methods of chemical control.

The chemistry monitoring programs at ANO-1 have been effective in managing the effects of aging. Through continued use of operating experience, the corrective action program, and industry guidance documents, the ANO-1 programs will continue to be effective during the period of extended operation.

3.3.1.2 Quality Assurance

Attributes of the Quality Assurance (QA) Program are described in Appendix B, Section 2.0, "Program and Activity Attributes" of the ANO-1 LRA. This section of the application states that the Quality Assurance Program corrective actions and administrative controls

apply to all aging management programs (AMPs) and activities discussed throughout the LRA.

The Entergy Quality Assurance Program applies to safety-related structures and components. Corrective actions and administrative (document) control for safety-related systems, structures, and components, non safety-related systems, structures, and components whose failure could prevent satisfactory accomplishment of any safety related function, and those systems, structures and components relied upon to perform a function necessary to demonstrate compliance with the Commission regulations cited under 10CFR54.4(a)(3) are accomplished under the existing ANO-1 Corrective Action Program and ANO-1 Document Control Program.

These two programs apply to the corrective actions and administrative controls for the programs and activities within the scope of license renewal.

The NRC Draft Standard Review Plan (DSRP), Section A.2, "Quality Assurance for Aging Management Programs," states that 10CFR Part 50, Appendix B (Appendix B) requirements, which apply to safety-related structures and components, are adequate to address the corrective actions, confirmation process, and administrative control elements of an AMP for license renewal. For non safety-related structures and components, an applicant may expand the scope of its Appendix B program to include these structures and components, or may choose an alternative approach to address corrective actions, confirmation process, and administrative control.

3.3.1.2-1 The description in Appendix B, Section 2.0, of the LRA appears to be consistent with the initial approach of expanding the scope of Appendix B to cover those non-safety related structures and components within the scope of license renewal. Please clarify as to whether the ANO-1 Appendix B, Corrective Action and Document Control Programs cover all non-safety-related structures and components within the scope of license renewal? If not, what alternative approach has been developed to address these attributes?

The corrective action program and the administrative (document) control program, which governs site procedures, are in accordance with the site-controlled quality assurance program pursuant to 10CFRPart 50, Appendix B. These programs apply to the nonsafety-related structures and components within the scope of license renewal.

3.3.1.2-2 **The description in Appendix B, Section 2.0, of the LRA does not specifically address the inclusion of the confirmation process as an attribute of each AMP that is addressed by the ANO-1 QA Program. Identify where in the LRA is the confirmatory process each AMP addressed. If the confirmatory process is not performed under the ANO-1 QA program, provide sufficient information to allow the staff to verify (consistent with Section A.1.2.3.8, "Confirmation Process," of the NRC DSRP) that the confirmation process corrective actions have been completed and are effective. Include a discussion on how the ANO-1 confirmation process ensures the adequacy, completeness, and effectiveness of corrective actions?**

The confirmation process is part of the ANO-1 corrective action program and is in accordance with the site-controlled quality assurance program pursuant to 10CFR Part 50, Appendix B. Thus the confirmation process applies to all of the aging management programs and activities described in Appendix B of the ANO-1 LRA as well as to all of the components and structures within the scope of license renewal.

3.3.1.2-3 **The definition in the LRA for "Acceptance Criteria or Standards" attribute states that the acceptance criteria or standards are described for the relevant conditions to be monitored or the chosen examination methods. The NRC DSRP states in part that the acceptance criteria should ensure that intended functions are maintained under all current licensing bases (CLB) design conditions during the period of extended operation and that the program should include a methodology for analyzing the results against applicable acceptance criteria. Please describe how the ANO-1 aging management review (AMR) ensures that intended functions are maintained consistent with the CLB during the period of extended operation and how the results of the program are analyzed against the applicable acceptance criteria?**

The ANO-1 aging management review assures that, for each identified aging effect for a specific structure or component, one or more aging management programs are identified to either (1) prevent the aging effect from occurring, or (2) detect, monitor and trend (when appropriate) the aging effect so that appropriate corrective actions can be taken, to ensure the structure or component will perform its intended function under current licensing basis design conditions during the period of extended operation. If an aging management program is designed to prevent an aging effect from occurring, the acceptance criteria for the program are the conditions that must exist to provide reasonable assurance that the aging effect will not occur.

If the aging management program is designed to detect, monitor and trend (when appropriate) an aging effect, the acceptance criteria for the program are conditions that require timely corrective action to ensure the structure or component will perform its intended function under current licensing basis design conditions. These criteria are often dependent on the frequency of the monitoring activity. In Appendix B of the ANO-1 LRA, the method section of each aging management program description discusses the type of action or technique used to manage the effects of aging. The results of implementing this method are compared to the acceptance criteria. If the acceptance criteria are not met, the site corrective action program is invoked to ensure the structure or component will perform its intended function under current licensing basis design conditions during the period of extended operation.

3.3.1.4.4-1 Appendix B of LRA "Aging Management Programs and Activities", Section 4.5 "Boric Acid Corrosion Prevention" states under "Aging Effects" that this program has been identified as managing the loss of material of bolting that could eventually result in loss of preload for bolted connections. Provide rationale as to why the program is not credited to manage aging effect of loss of material in reactor vessel head due to any coolant leakage from control rod drive penetrations or other vessel head penetrations.

As indicated in Table 3.2-1, Entergy Operations credits the Boric Acid Corrosion Prevention Program for managing loss of material on control rod drive mechanism flanges (or any other vessel head penetrations). On page 3-25, we credit the Boric Acid Corrosion Prevention Program for the reactor vessel. On page 3-32, Entergy Operations credits the Boric Acid Corrosion Prevention Program for reactor vessel bolting including bolting used on control rod drive penetrations.

3.3.1.4.4-2 Does the site Quality Assurance Program pursuant to 10CFR50, Appendix B address the "confirmation" element of all the AMP describe under Appendix B?

Yes, the ANO-1 Corrective Action Program, which includes the confirmation process, and the administrative (document) control program, which governs site procedures, were credited for license renewal. These programs are in accordance with the corporate quality assurance program pursuant to 10CFR Part 50, Appendix B. As discussed in Section 2.0 of Appendix B of the ANO-1 LRA, these programs apply to all of the programs described in Appendix B of the ANO-1 LRA.

3.3.1.4.9 American Society of Mechanical Engineers (ASME) Section XI Inservice Inspection

Are there components or structures within the inservice inspection boundary that are either inaccessible or cannot be examined in accordance with the applicable Code due to geometry and/or physical constraints? If there are, please provide a summary to address the following elements for inaccessible areas:

(a) Preventive actions that will mitigate or prevent aging degradation;
(b) Parameters monitored or inspected relative to degradation of specific structures and component intended functions;
(c) Detection of aging effects before loss of structure and component intended functions;
(d) Monitoring, trending, inspection, testing frequency, and sample size to ensure timely detection of aging effects and corrective actions;
(e) Acceptance criteria to ensure structure and component intended functions; and
(f) Operating experience that provides objective evidence to demonstrate that the effects of aging will be adequately managed.

Portions of the ANO-1 structures and components within the scope of license renewal are located in areas that are inaccessible for inspection. The ANO-1 aging management review process methodically:

- identifies environments for the structures and components subject to aging management review,
- evaluates the material-environment combination for the structures and components to determine applicable aging effects, and
- identifies the program that will manage the applicable aging effects.

The purpose of the aging management review is to adequately manage the effects of aging so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation. The aging management review includes several steps: (1) identify the applicable aging effects for the structure or component; (2) identify existing or new programs for managing the applicable aging effects; and (3) demonstrate that the program is effective in managing the aging effects so that the intended function(s) will be maintained consistent with the current licensing basis for the period of extended operation. The location of a structure or a component is a factor in identifying the applicable aging effect(s) and in determining the appropriate aging management activity.

The aging effects for a structure or component occur due to the combination of material and environment. Structures and components that are inaccessible for inspection may be exposed to unique environments because of their location. The condition of the inaccessible structure or component can be established by identifying the environment and determining if subjecting the structure or component to the environment results in aging effects that could degrade the condition of the component. The inaccessible environment is evaluated as part of the aging management review to determine the applicable aging effects for structures and components located in this environment.

The ANO-1 aging management review considered environmental conditions to which the structures and components are exposed, including those conditions in areas that may turn out to be inaccessible for inspection. For example, structures and components located below grade may be exposed to groundwater. Therefore, the unique environment (groundwater) of the inaccessible structure or component was considered as part of the aging management review. In many instances, the proper selection of materials for the inaccessible environment results in few, if any, applicable aging effects.

The aging management review may determine that the environmental differences based on the location (such as concrete above grade exposed to air versus concrete below grade exposed to groundwater) do not result in unique aging effects for the inaccessible structure or component. Where the conditions in the inaccessible and accessible areas result in the same aging effects, the aging management program of the inaccessible area may be based on symptomatic evidence in an accessible area. For example, the aging effect due to alkali-aggregate reactions of concrete would be manifest in both accessible and inaccessible areas.

For the case where symptomatic evidence in accessible areas provides indications of aging effects in inaccessible areas, the aging management review assures that the aging effects due to the environment in the accessible region and the aging effects due to the environment in the inaccessible region are simultaneously evaluated. This parallel aging of components with similar materials in accessible and inaccessible locations forms the basis for the ASME Section XI approach to programmatically deal with inaccessible locations that require assurance of integrity.

When different aging effects due to environmental differences such as a more aggressive environment in the inaccessible area exist, other aging management approaches are needed. The key for the aging management review of these inaccessible areas is the knowledge of the environmental differences, such as more aggressive external environments due to the chemical composition of groundwater. The controlling of the most susceptible location to aging, where the aging effects are more likely to be accelerated, limits the need for programmatic examination to the controlling location. For the controlling locations, a number of options exist that will assure that the structure or component intended function is maintained. These programmatic examinations may include, but are not limited to, remote examination techniques, disassembly, or excavation.

For components and structures that are subject to aging management review and are within the scope of the ASME Section XI Inservice Inspection Program, the ANO-1 aging management review did not identify inaccessible environments that result in aging effects different from those in the accessible environments. Thus, the ASME Section XI inservice inspections of accessible areas can be thought of as a sample, representative of both accessible and inaccessible areas. When an unacceptable condition or situation is identified for an accessible area, a determination will be made as to whether the same condition or situation is applicable to other accessible or inaccessible areas, and what additional actions need to be taken.

Furthermore, the ANO-1 ASME Section XI Inservice Inspection Program is an existing program that is part of ANO-1's current licensing basis to meet the requirements of 10CFR50.55(a). The approach for managing inaccessible areas described above is currently used to ensure that applicable components and structures continue to perform their intended functions. ANO-1 operating experience has shown that this approach is effective in managing aging effects. Descriptions of the ASME Section XI Inservice Inspection Program attributes, such as those listed in items (a) through (f) of this RAI, were provided in the subsections to Section 4.3 of Appendix B of the ANO-1 LRA.

3.3.3.1-1 **Appendix B, Section 1.1, Mechanical Components Subject to Aging Management Review, lists components subject to review in the LRA. In addition to piping, valve bodies, pump casings, etc., Section 1.1 includes flex hoses, filter housings, expansion joints, traps, flow orifices, inline flow meters, cyclone separators, and miscellaneous processing components. Tables 3.3-1 through 3.3-8 do not contain a similar list of components. Add the missing components to Tables 3.3-1 through 3.3-8 or provide a justification for excluding any of these components, or if addressed elsewhere, reference the section.**

Appendix C, Section 1.1, Mechanical Components Subject to Aging Management Review, lists components subject to review in the ANO-1 LRA.

There are no flex hoses, filter housings, expansion joints, traps, inline flow meters, cyclone separators, or miscellaneous processing components that require an aging management review in the core flood system. Table 3.3-1 for the core flood system, includes orifices as a component commodity grouping.

There are no flex hoses, filter housings, expansion joints, or traps that require an aging management review in the low-pressure injection/decay heat removal system. Table 3.3-2 for the low-pressure injection/decay heat removal system, includes (cyclone) separators as a component commodity grouping. Flow elements, flow orifices and venturies (miscellaneous processing components) are included in the stainless steel "flow element" component commodity grouping.

There are no flex hoses, expansion joints, miscellaneous processing components or traps that require an aging management review in the makeup and purification/high pressure injection system. Table 3.3-3 for the makeup and purification/high pressure injection system includes flow elements, (cyclone) separators and filters as component commodity groupings. Flow orifices are included in the stainless steel "piping" component commodity grouping.

There are no flex hoses, filter housings, flow orifices, expansion joints, miscellaneous processing components or traps that require an aging management review in the reactor building spray system. Table 3.3-4 for the reactor building spray system includes (cyclone) separators as a component commodity grouping. Flow elements are included in the "flow element" component commodity grouping.

There are no flex hoses, expansion joints, traps, flow orifices, inline flow meters, cyclone separators or miscellaneous processing components that require an aging management review in the reactor building cooling and purge system. Filters are encompassed by the fan housings and are included in the "fan and cooler housings" component commodity grouping in Table 3.3-5 for the reactor building cooling and purge system.

There are no flex hoses, filter housings, expansion joints, traps, inline flow meters, cyclone separators or miscellaneous processing components that require an aging management review in the sodium hydroxide system. Flow orifices are included in the "piping" component commodity grouping in Table 3.3-6 for the sodium hydroxide system.

There are no flex hoses, filter housings, expansion joints, traps, flow orifices, inline flow meters, cyclone separators, and miscellaneous processing components that require an aging management review in the reactor building isolation system.

There are no flex hoses, filter housings, flow orifices, expansion joints, traps, inline flow meters or cyclone separators that require an aging management review in the hydrogen control system. Table 3.3-8 for the hydrogen control system includes recombiners and sample stations (miscellaneous processing components) as component commodity groupings. Flow elements are included in the "piping" component commodity grouping.

Section 1.1 of Appendix C addresses mechanical components throughout the plant while this RAI specifically requested information pertinent to Tables 3.3-1 through 3.3-8. While expansion joints and traps do not appear in these tables they are, for example, included explicitly in Table 3.4-3 (expansion joints) and Table 3.5-1 (traps).

3.3.3.1-2 **Based on Table 3.3-1 being a complete list of components, materials and environments, and aging effects associated with the low pressure injection/decay heat removal (LPI/DHR) system, address the following:**

(a) Two cavitation venturies associated with the discharge lines from the LPI/DHR removal pumps (typically found in the B&W design) were not included on the list of components. Identify the aging effects associated with the material, environment, and operation of these components or, if addressed elsewhere, reference the section.

In Table 3.3-2 of the ANO-1 LRA for the low pressure injection/decay heat removal system, venturies are included in the stainless steel "flow element" with borated water environment component commodity grouping. The aging effects for these venturies are cracking and loss of material (aging effects prevented by referenced program or activity), and the aging management program for managing these aging effects is the Primary Chemistry Monitoring Program. For this component commodity grouping, in addition to cracking, Table 3.3-2 also should have listed loss of material as an applicable aging effect. Not listing this aging effect was an administrative error in compiling the results of the aging management review.

(b) What material (such as epoxy-phenolic, typically found in carbon steel tanks) forms the internal surfaces of the borated water storage tank (BWST)? If a material other than carbon steel forms the internal surface, identify the material, associated aging effects, and program/activity for this internal surface of the BWST.

The BWST is carbon steel and is coated with Plastite. The aging effects and aging management program are based on the carbon steel structure of the BWST and are identified in Table 3.3-2 of the ANO-1 LRA. As part of the Preventive Maintenance Program, the tank is inspected internally each refueling outage. This inspection is being enhanced to specifically require that the Plastite coating be inspected to verify coating integrity. Verification that the coating remains intact ensures that loss of material of the BWST carbon steel internal surfaces is not occurring.

(c) Are the external surfaces of the BWST/components, BWST discharge piping, or other engineered safety feature (ESF) piping imbedded in concrete or exposed to an environment other than a controlled air environment? Is the piping subject to uncontrolled external weather conditions such as acid rain, ground water, heat, and humidity? Cracking or loss of material are typically considered aging effects for carbon and stainless steel in these types of environments. If not, discuss the reasons why these effects are not applicable. If cracking or loss of material are potential aging effects for ESF piping, identify the associated program/activity (in-service inspection, maintenance rule, boric acid corrosion prevention, etc.) for managing these aging effects.

The BWST is outdoors, and the tank is exposed to ambient weather conditions in the outdoor environment. The BWST sits on a ring foundation filled with oiled sand. The outer periphery of the tank bottom is in contact with the concrete shoulder of the foundation. The remainder of the bottom is in contact with the oiled sand. The piping runs through the tank bottom, the tank foundation oiled sand, concrete and into the auxiliary building.

Cracking of the BWST carbon steel external surfaces that are exposed to the outdoor environment is not an applicable aging effect. Industry data does not indicate that cracking of low strength carbon steel occurs.

Please see Tables 3.3-1 through 3.3-8 of the ANO-1 LRA regarding aging effects requiring management for engineered safeguards systems. These tables also indicate the programs and activities credited to manage the effects of aging for the components in these systems.

3.3.3.1-3 **Section 2.3.2.3, 4, and 5 of the LRA states that seven high pressure injection (HPI) system mechanical reactor building penetrations are within the scope of the review. Tables 3.3-3, -4, and -5 do not list the penetrations as components or provide sufficient information to adequately assess aging management concerns for these components. Add the missing components to Tables 3.3-3, -4, and -5 or provide a justification for excluding any of these components, or if addressed elsewhere, reference the section.**

Please see Section 3.6.1 of the ANO-1 LRA which discusses steel components of structures including penetrations. Also, see Table 3.6.2 that evaluates mechanical penetrations as a component commodity grouping, including the seven HPI system mechanical reactor building penetrations.

3.3.3.1-4 **Based on Table 3.3-3 being a complete list of components, materials and environments, and aging effects associated with the HPI systems, address the following:**

(a) Is there a potential for the brass/bronze valves in the HPI system to be exposed to environments other than ambient-air (i.e., lube oil leakage, boric acid leakage, etc.) If so, justify why loss of material is not an applicable aging effect.

The brass and bronze valves in the HPI system are not normally exposed to external environments other than ambient-air. Frequent operator rounds during the course of normal plant operation make it highly unlikely that brass or bronze valves in the HPI system will experience significant exposure to external environments other than ambient-air.

The industry and site operating experience review performed during the aging management review did not indicate that loss of material for brass or bronze valves in the HPI system due to leakage has been an issue.

(b) Is there a potential for the HPI gear drive reservoirs and associated pumps to be exposed to potentially corrosive environments. If so, justify why loss of material is not an applicable aging effect.

The HPI gear drive reservoirs and associated pumps are not normally exposed to potentially corrosive environments. Frequent operator rounds during the course of normal plant operation make it highly unlikely that gear drive reservoirs or associated pumps will experience significant exposure to potentially corrosive environments.

3.3.3.1-5 **Alternate wetting of the surfaces of reactor building spray piping with boric acid solution and subsequent drying (conditions experienced during surveillance testing) could concentrate boric acid, and possibly halogens and sulfates, and create environments conducive to loss of material and cracking. Identify in the LRA where these aging effects are addressed. If not, justify the exclusion of the loss of material and cracking as applicable aging effects for this system.**

The spray headers and some of the discharge header piping internal to the reactor building are normally dry. Portions of the piping are exposed to alternating wetting and drying conditions. Table 3.3-4 of the ANO-1 LRA indicates that cracking is an aging effect that is prevented by chemistry control programs. Due to an administrative error, Table 3.3-4 should have listed loss of material as a potential aging effect that is prevented by the same chemistry control programs.

3.3.3.1-6 **Based on Table 3.3-5 being a complete list of components, materials and environments, and aging effects associated with the reactor building cooling and purge system address the following:**

(a) Typically, materials such as aluminum, galvanized steel, stainless steel, duct sealants, etc. are used in reactor building cooling system components such as ducts, filters, grills, seals, etc. If these or any other materials other than carbon steel are used in the reactor building cooling and purge system, address the potential for loss of material and cracking in applications where the materials are used and identify the associated program/activity for managing these aging effects.

Neither aluminum nor stainless steel is used in reactor building cooling system components such as ducts, filters, grills, or seals requiring an aging management review. Galvanized steel was conservatively evaluated as carbon steel in the aging management review.

The gaskets, which seal the bolted connections, did not undergo aging management review. The ANO-1 position on gaskets is based on BAW-2244A. The resolution to RAI 9, contained in NRC letter from C.I. Grimes to D.J. Firth, dated November 26,1997, subject: "Clarification in the Final Safety Evaluation Report for BAW-2244, Demonstration of Management of Aging Effects for the Pressurizer," is that gaskets support the pressure boundary component intended function but are not subject to aging management review.

(b) Appendix C of the LRA, Section 8.3.1, addresses the aging effect of loss of material on copper materials in an external ambient environment. Is there any equipment (i.e., equipment listed in Table 3.3-5) made of copper alloy (e.g., 90/10 CuNi) exposed to a gas-air environment and, if so, address the potential for the loss of material as an applicable aging effect and identify the associated program/activity for managing the aging effect.

Appendix C of the ANO-1 LRA, Section 8.3.1, discusses the aging effect of loss of material on copper materials in an ambient environment if the material is in contact with moist air. The air that is flowing over the CuNi heat exchanger tubes included in Table 3.3-5 of the ANO-1 LRA has been filtered and cooled by the pre-filters and chilled water coils that are upstream, thereby removing particulates and moisture. The aging management review concluded there were no aging effects affecting the pressure boundary requiring management for external surfaces of the CuNi tubes because the air flowing over them is dry.

This conclusion is supported by the operating experience review, which did not reveal degradation of CuNi in dry air.

3.3.3.1-7 In the ANO-1 LRA, Appendix C, Section 5.1, the sodium hydroxide is indicated to have high levels of chlorides as impurities. Stainless steels resist cracking in chloride-contaminated sodium hydroxide, even when oxygen is present, though it is not clear what chloride levels are acceptable. Also, it is not clear how chloride affects stress corrosion cracking and loss of material for carbon steels. Indicate the range of chloride levels that exist in the sodium hydroxide tank solution and provide a specification for maximum chloride impurity that assures ample aging margins for both stainless steel and carbon steel. In addition, other impurities should be considered. Are chemical analyses conducted to characterize impurity species and levels, such as fluorides, hypochlorites, and sulfur compounds? If significant impurity species and levels are detected, provide a justification that the species detected do not promote significant degradation of stainless steel or carbon steel components? Provide a justification as to why "water chemistry" is not indicated as a program/activity for managing aging effects in the sodium hydroxide system.

Please note that Table 3.3-6 of the ANO-1 LRA indicates loss of material is the aging effect for the carbon steel sodium hydroxide tank. The table also indicates loss of material and cracking are aging effects for the stainless steel piping and valves. Aging is managed by detection and trending through ASME Section XI Inservice Inspection (ISI)-IWD, NaOH Tank Level Monitoring, and Wall Thinning Inspection. Chemistry control programs are not credited as aging management programs.

3.3.3.1-8 The maximum allowable solution temperature in the sodium hydroxide storage tank is indicated to be 120F (49C) (Section 6.2.2.4.6, Appendix No. 15). Are stainless steel components in the sodium hydroxide system potentially subject to the maximum temperature? If so, the temperature seems questionably close to the "tentative safe SCC limit" for stainless steel in a sodium hydroxide environment at 20 wt percent, indicated to be about 55C (estimated) [Ref. A. John Sedriks, "Stress Corrosion Cracking of Stainless Steels," in *Stress Corrosion Cracking,* R.H. Jones, Ed., p.114, ASM International, Materials Park, Ohio (1992)]. The cracking threshold for carbon steel in 20% sodium hydroxide is about 70C, only about 20C above the maximum temperature specification for the sodium hydroxide tank [Ref. Denny A. Jones, *Principles and Prevention of Corrosion*, p. 394. Macmillan, New York (1992)]. Of concern is

whether chlorides lower the cracking threshold temperature for carbon steel. Indicate the temperature and impurity limits that apply to the sodium hydroxide system that will prevent stress corrosion cracking of stainless steel and carbon steel.

The tank is located outdoors. Operator logs give a maximum temperature of 95 F, and a review of the operator logs for the last year shows that this maximum temperature was never reached. Although the allowable and observed temperatures are lower than those of concern as noted in the RAI, Entergy Operations considered loss of material as an aging effect requiring management for the carbon steel tank and loss of material and cracking as aging effects requiring management for the stainless steel piping and valves. Please refer to Table 3.3-6 of the ANO-1 LRA for the programs or activities that manage these aging effects. Cracking of the carbon steel tank is not an applicable aging effect since the cracking threshold temperature for carbon steel in 20% sodium hydroxide, about 158 F, is significantly above both the maximum allowable temperature and the observed temperature of the sodium hydroxide storage tank.

3.3.3.2-1 **Identify where in the LRA cracking of the BWST is addressed or justify why this aging effect is not applicable to the ANO-1 BWST.**

The BWST is carbon steel. Carbon steel is not susceptible to cracking in a borated water environment. Loss of material, as indicated in Table 3.3-6 of the ANO-1 LRA, is the aging effect requiring management for this tank.

3.3.3.2-2 **Tables 3.3-2, 3.3-3 and 3.3-4 address heat exchangers (lube oil coolers) in the reactor building spray system as well as the LPI/DHR and the makeup and purification (MUP)/HPI systems. The oil analysis program of Appendix B is credited for ensuring that oil is free of water or contaminants and manages the aging effects of cracking and loss of material. Table 3.3-2 identifies loss of material as the aging effect for the pressure boundary function, but does not identify cracking as an applicable aging effect for heat exchangers. Table 3.3-3 identifies cracking as the aging effect for the pressure boundary function, but not loss of material. Table 3.3-4 is silent regarding the function of the pressure boundary. Discuss each of the following: 1) loss of material and cracking aging effects, 2) the pressure boundary function, and 3) applicable AMPs for heat exchangers in each of the three tables discussed above.**

Table 3.3-2, Table 3.3-3, and Table 3.3-4 of the ANO-1 LRA should each indicate for the lube oil coolers that there is a pressure boundary and heat transfer function. The pressure boundary aging effects on the lube oil side of each lube oil cooler should be indicated as loss of material and cracking (aging effects prevented by referenced program or activity), both managed by the Oil Analysis Program. These are administrative errors in compiling the information from the aging management review.

3.3.3.3-1 **Identify where in the LRA cracking of the core flood tanks (CFTs) is addressed or justify why this aging effect is not applicable to the ANO-1 CFTs.**

Please see Table 3.3-1 of the ANO-1 LRA, which indicates the CFT stainless steel cladding and Inconel components have cracking as the aging effect. Note that this aging effect is prevented by the credited programs.

3.3.3.3-2 **Section 3.3.3 of the Applicant's LRA states that ASME Section XI is applicable to all engineered safeguards systems with exception of reactor building cooling and purge and hydrogen control systems. Tables 3.3-1, 2, 3, and 4 do not contain this as an AMP for certain components (i.e., BWST, LPI/DHR piping, makeup and purification piping, etc.). Add the missing AMP to Tables 3.3-1 through 3.3-4 or provide a justification for excluding the AMP.**

Section 3.3.3 of the ANO-1 LRA is correct in stating that ASME Section XI ISI Program is applicable to engineered safeguards systems except reactor building cooling and purge and hydrogen control systems. It does not state that it is applicable to all components in all of these systems. It also does not state that ISI is being credited as an aging management program for all components to which it applies. Table 3.3-1, Table 3.3-2, Table 3.3-3, and Table 3.3-4 correctly indicate when the ASME Section XI ISI-IWC inspections are credited as an aging management program.

3.3.3.3-3 **Table 3.3-2 does not list the BWST heat exchanger as a component that is subject to an AMR nor does it appear to list all aging effects that may potentially affect the heat exchanger. Identify where in the LRA loss of material and fouling for this heat exchanger are addressed or justify why these aging effects are not applicable.**

Borated water storage tank heaters are shown on Table 3.3-2 of the ANO-1 LRA (page 3-44) under the component commodity grouping "heaters" as having been evaluated in the aging management review for the pressure boundary intended function at the interface point between the heaters and the BWST. Please note these are electric heaters and electrical heaters have been determined by the NRC Staff to be active components and not subject to an aging management review. There is no BWST heat exchanger.

3.3.3.3-4 **Identify where in the LRA loss of material (from crevice corrosion and pitting) and boric acid corrosion (of external surfaces) for the reactor coolant, HPI, and LPI pump seals in borated water are addressed, or justify why these aging effects are not applicable to these pump seals.**

As noted in 10CFR54.21(a)(1)(i), "pumps (except casing)" are active components and are excluded from an aging management review. Pump seals are not a part of the casing and are therefore not subject to aging management review.

3.3.3.3-5 **Boric acid is a prominent environment in the core flood, low pressure injection, and high pressure injection systems. Intergranular stress corrosion cracking (IGSCC) of stainless steels in weld heat-affected zones is a known applicable aging effect in a borated water environment, particularly in stagnant systems. This aging effect was not identified as applicable in stagnant portions of system in the LRA. Chlorides and sulfates present in this environment also impact this aging effect. In the LRA, the control of chlorides and sulfates is specified at levels below 0.05 ppm in the primary system water chemistry control program. Do the same levels apply to the applicable ESF systems? If so, do ANO-1 operating history and chemistry records confirm that the specifications are consistently met and are being effective in controlling IGSCC in the applicant's ESF systems? If not being consistently met, what steps are being taken to verify that levels will be met to ensure satisfactory aging management during the period of extended operation?**

IGSCC is an aging mechanism that can cause the aging effect of cracking. Cracking is identified as an aging effect for stainless steel in a borated water environment in Table 3.3-1, Table 3.3-2, Table 3.3-3, Table 3.3-4, and Table 3.3-7 of the ANO-1 LRA. Primary Chemistry Monitoring and Secondary Chemistry Monitoring are listed among the programs and activities in these tables to manage this aging effect. Please see the discussions on pages B-46 and B-47 for discussions of operating experience of these programs or activities.

3.3.3.3-6 **A review of plant history has indicated that sections of ANO-1 core flood, low pressure injection, and/or high pressure injection system**

piping or other components have been replaced or have had other significant modifications made to the systems. Were these modifications made as a result of aging? If so, what was the aging effect that resulted in the replacements? Have there been additional replacements since the original replacement campaigns? If so, what is the evidence from corrective procedures and current surveillance programs that the original aging effect(s) have been eliminated?

IE Circular 76-06, NRC Bulletin 79-17, and NRC Information Notices 79-19, 80-05, 80-15, and 84-18 identified the potential for IGSCC in stainless steel piping, including piping associated with the emergency core cooling system (ECCS). IGSCC occurred in ECCS piping at ANO-1 because of sodium thiosulfate contamination of the piping. The sodium thiosulfate storage tank and its piping were removed from service (spared in place). ECCS piping and components were replaced. Water quality is monitored at ANO-1 to ensure this type of incident does not recur. There have been no similar issues since. Routine ISI–IWC inspections have not indicated cracking issues for the piping in these systems.

3.3.3.3-7 **The applicant's LRA lists, in addition to ASME Section XI, preventive maintenance, maintenance rule, and level monitoring as appropriate programs/activities for ASME Class 1, 2, and 3 tanks such as the demineralized water storage tank. Table 3.3-2 only identified preventive maintenance (and did not apply these other programs) as an AMP for the BWST. Correct this discrepancy and based on the AMP included, provide a demonstration that the effects of aging will be managed such that the current licensing basis will be maintained during the period of extended operation.**

Because the BWST is not within the scope of the NRC-approved ASME Section XI ISI program, this program cannot be credited for aging management for the BWST. Crediting only the Preventive Maintenance program to manage the effects of aging for the BWST is not a discrepancy. As noted in Section 4.15 of Appendix B of the ANO-1 LRA (page B-76), the BWST inspections in this program include both internal and external visual inspections of the tank. During a one-time special inspection, both ultrasonic testing and visual inspections of the BWST were performed. The inspections verified no loss of material to the tank shell. The results of the internal and external inspections indicating no degradation, demonstrate the effects of aging will be managed such that the current licensing basis will be maintained during the period of extended operation.

3.3.3.3-8 **Table 3.3-2 addresses heat exchangers in the LPI/DHR system (DHR coolers) and lists AMPs for the aging effects of fouling associated with the heat transfer function of the heat exchangers. The heat exchanger monitoring program described in Appendix B of the LRA is credited with managing the effects of aging on the heat transfer function. The program described in Appendix B focuses on inspections for structural integrity concerns and does not address the loss of the heat transfer function. Identify where in the heat exchanger monitoring program the inspection activities are intended to identify fouling or identify any other program activities that will address the potential for fouling.**

In addition, Table 3.3-2 lists LPI/DHR lube oil coolers as a component covered by aging management programs. It also lists management programs for the aging effects of fouling on the heat transfer function of the heat exchangers. Section 4.14, Oil Analysis, of Appendix B is credited for managing the effects of aging on the heat transfer function. The program described in Appendix B shows that it focuses on degradation of lube oil coolers that would result in contamination of oil by contact with water. Provide information on other programs at ANO-1 that would specifically relate to the management of the aging effects of fouling on the heat transfer function of lube oil coolers.

Due to an administrative error, Table 3.3-2 of the ANO-1 LRA is incorrect in crediting the Heat Exchanger Monitoring Program and ASME Section XI ISI-IWC for managing fouling of the decay heat coolers (DH coolers). The only program credited for managing fouling is the Service Water Integrity Program, described on page B-90, which includes heat transfer testing of these heat exchangers.

For the lube oil coolers, the Oil Analysis Program, as stated on page B-74, " ... has been credited for ensuring the oil is free of water or contaminants." Without water or contaminants in the oil, there is no fouling on the lube oil side of the coolers as has been demonstrated by ANO-1 and industry operating history. Fouling on the service water side of the lube oil coolers is addressed by Service Water Integrity Program.

3.3.3.3-9 Appendix B, Section 4.4, Bolting and Torquing, of the applicant's LRA describes a program for aging management of carbon steel bolts in the ESF systems. Tables 3.3-1, -2, -3, -4, -6, and -7 do not identify this activity as applicable to the respective systems. Add the missing program to these tables or provide a justification for excluding this program.

While the same procedures may be used for bolting in the engineered safeguards systems, Bolting and Torquing Activities are credited only for the reactor coolant system. Please note on page B-42 the regulatory basis for the activities is "0CAN088201, AP&L Response to IEB 82-02, Degradation of Threaded Fasteners in the Reactor Coolant Pressure Boundary of PWR Plants." Table 3.3-1, Table 3.3-2, Table 3.3-3, Table 3.3-4, Table 3.3-6, and Table 3.3-7 of the ANO-1 LRA indicate several other programs used to manage the effects of aging for bolting in engineered safeguards systems. These programs are described in Appendix B of the ANO-1 LRA.

3.3.3.3-10 Provide a justification for not including loss of material as an applicable aging effect for stainless steel piping and fittings, and flow orifices in the reactor building spray system, core flood system, LPI/DHR system, makeup and purification system, and reactor building isolation system, Tables 3.3-1, 2, 3, 4, and 7, in a borated water environment.

Section 3.3.2 (page 3-40) of the ANO-1 LRA should also identify loss of material as an applicable aging effect for stainless steel components exposed to borated water in the reactor building spray, core flood, low pressure injection/decay heat removal, makeup and purification/high pressure injection and reactor building isolation systems. Table 3.3-1 should have "Loss of material[(1)]" inserted under "Cracking" in the two stainless steel rows. Table 3.3-2 should have "Loss of material[(1)]" inserted under "Cracking" in the first row. Table 3.3-3 should have "Loss of material[(1)]" inserted under "Cracking" in the first row. Table 3.3-4 should have "Loss of material[(1)]" inserted under "Cracking" in the first stainless steel row. Table 3.3-7 should have "Loss of material[(1)]" inserted under "Cracking" in the last row. The noted omissions were due to an administrative error in compiling the results of the aging management review.

3.3.3.3-11 Provide a justification for not including loss of material as an applicable aging effect for carbon steel bolting in an air environment in the reactor building spray system and other ESF systems.

Loss of material is not an applicable aging effect for carbon steel bolting in a normal plant environment as discussed in Section 9.3.2 of Appendix C. In Table 3.3-1, Table 3.3-2, Table 3.3-3, Table 3.3-4, Table 3.3-6, and Table 3.3-7 of the ANO-1 LRA, carbon steel bolting is shown with loss of material as an applicable aging effect with an environment of borated water due to "Component/system leakage." The normal environment for this bolting is air.

3.3.3.3-12 Table 3.3-4 does not address an operational leakage monitoring or housekeeping program to monitor the aging effects from boric acid deposits and potential corrosion to external surfaces for the reactor building spray system and other ESF systems. Identify in the LRA where boric acid corrosion on the external surfaces of the reactor building spray system components, due to exposure to borated water from within the reactor building spray system or other adjoining systems, is addressed or justify why this aging effect is not applicable to these components.

Table 3.3-4 of the ANO-1 LRA shows for carbon steel bolting and external valve parts, in a borated water environment, due to component or system leakage, that loss of material and loss of mechanical closure integrity are aging effects managed by the Boric Acid Corrosion Prevention Program and ASME Section XI ISI-IWC activities. The other system components are stainless steel as shown in the table. Also, as discussed in Section 4.5 of Appendix B, the purpose of the Boric Acid Corrosion Prevention Program is to prevent corrosion damage due to leakage from the borated water systems at ANO-1.

3.3.3.3-13 Section 3.3.3 of the LRA indicates that the heat exchanger monitoring program is applicable to the coolers of the reactor building cooling and purge, LPI/DHR, and makeup and purification systems. Tables 3.3-2, 3.3-3, and 3.3-5 do not list the heat exchanger monitoring program. Add the heat exchanger monitoring program to these tables or provide a justification for its exclusion.

The Heat Exchanger Monitoring Program is credited in Table 3.3-2 for managing loss of material of the decay heat coolers. This program is also applicable to the reactor building cooling and purge system and the MUP/HPI system as discussed in Section 3.3 of Appendix B. Table 3.4-10 of the ANO-1 LRA credits this program for the service water side of the coolers in these systems. Tables 3.3-3 and 3.3-5 do not credit this program for the non-service water side of the coolers since other programs or activities adequately manage the applicable aging effects.

Also, in Table 3.3-2 for heat exchangers (DH coolers), neither Heat Exchanger Monitoring nor ASME Section XI ISI-IWC (pressure tests) should be credited for managing fouling. Inclusion of these programs to manage fouling was an administrative error. The Service Water Integrity Program, as shown in Table 3.3-2, manages fouling of the DH coolers.

3.3.3.3-14 Table 3.3-6 indicates that loss of material and cracking are credible aging effects for stainless steel piping and valves. The corresponding aging management activities are indicated to be pressure tests and tank level monitoring. The staff, in general, does not accept "failure detection" as an acceptable AMP. What programs and activities are in place to detect degradation for the sodium hydroxide system before leaks or breaks occur?

The sodium hydroxide system stainless steel piping and valves do require an additional inspection to ensure the aging effects of cracking and loss of material are managed. Due to an administrative error in transferring the information from the aging management review report to the ANO-1 LRA, this additional inspection was omitted. The additional volumetric inspection before the end of the current license period will verify stainless steel components are not experiencing cracking or loss of material. This one-time inspection will be part of the ASME Code Section XI ISI-Augmented Inspections (Appendix B, Section 4.3.7) and will be conducted in accordance with the ASME Code Section XI. The results from this one-time inspection will then be evaluated. If the results indicate a potential for loss of intended function during the period of extended operation, the corrective action program will be used to identify and implement any additional corrective actions, which may include further inspection.

3.3.4.3.1-1 Respond to the following comments relating to the discussion of corrosion mechanisms in Appendix C, Section 1.4, of the LRA, and provide supporting references, as applicable.

(a) Oxygen can be a contributor but is not needed for pitting or crevice corrosion of metal. Verify that you are in agreement with this fact.

Entergy Operations agrees.

(b) Appendix C, page C-10, contains a statement that "[s]tress corrosion cracking and intergranular attack require a susceptible material, a corrosive environment, and tensile stress." Tensile stress is not needed for intergranular attack. Verify that you are in agreement with this fact.

A discussion related to stress corrosion cracking of carbon and other low-alloy steels were also included. This discussion concluded that the most common mechanism for cracking of high strength carbon and alloy steels is "aqueous chloride" cracking. This is an incorrect statement. Any steel with a tensile strength greater than 170 ksi is susceptible to stress corrosion cracking in a moist air environment. Verify that you are in agreement with this fact. In addition, verify that high strength bolting is not in use at ANO-1 in non-Class 1 applications. If high strength bolting is used at ANO-1, identify where in the LRA is the AMR for this bolting, or provide an AMR and a demonstration that the applicable aging effects will be managed consistent with the CLB for the period of extended operation for these bolts.

Entergy Operations agrees that tensile stress is not needed for intergranular attack. The materials used in bolting and threaded connections within the scope of license renewal are primarily carbon and low-alloy steels and stainless steel. At ANO-1, the aging effects were identified based on the material of the bolting without segregating high strength bolting. Cracking was identified as an aging effect that could be caused by stress corrosion cracking in bolting material subject to water or steam (e.g., from leakage) that contains various contaminants. Cracking of non-Class 1 bolting in an air environment has not been observed at ANO-1 and was not identified in a survey of industry experience. Therefore, for ANO-1, cracking of non-Class 1 bolting in an air environment is not an applicable aging effect.

(c) The referenced discussion contains a statement that stress corrosion cracking of stainless steels exposed to atmospheric

conditions is plausible when high levels of contaminants (e.g., chlorides) are present and only if the material is sensitized. Provide a technical justification for the statement that stainless steel needs to be sensitized to contaminants, and specifically address the need for austenitic stainless steel to be sensitized to chloride for chloride stress corrosion cracking to occur. If not, provide an AMR for chloride stress corrosion cracking in austenitic stainless steel.

Entergy Operations agrees that austenitic stainless steel does not need to be sensitized for stress corrosion cracking to occur. In performing the aging management review, it was assumed that, if stainless steel was exposed to an external environment that contained a high level of contaminants (e.g., chlorides), cracking was an applicable aging effect regardless of whether the stainless steel was sensitized. At ANO-1, the only stainless steel component found to be subject to an external environment that could contain a high level of contaminants was the spent fuel liner plate. Table 3.4-1 of the ANO-1 LRA indicates that cracking is an applicable aging effect for this component.

3.3.4.3.1-2 The following requests apply to all thirteen auxiliary systems:

(a) Section 4.3 of the LRA identifies metal fatigue as a time limited aging analysis (TLAA) and states that fatigue evaluations were required in the design of the ANO -1 Class 1 components in accordance with the requirements of the applicable design codes. The discussion of cyclic loading and fatigue is limited to Class 1 piping and components. However, many of the auxiliary systems addressed in the LRA, Section 3.4, are Class 2 and 3 components and are designed to American National Standards Institute (ANSI) B31.1 and B31.7 Code requirements. Although these codes do not require an explicit fatigue analysis, they do specify allowable stress levels based on the number of anticipated thermal cycles. Identify where in the LRA is cyclic loading and fatigue of Class 2 and 3 components addressed, or provide such an analysis for the applicable components.

Cyclic loading and metal fatigue of ANO-1 non-Class 1 components were evaluated by Entergy Operations as part of the aging management reviews of non-Class 1 systems within the scope of license renewal. The non-Class 1 design codes such as ANSI B31.1 and B31.7 do not require an explicit fatigue analysis but instead specify allowable stress levels based on the number of anticipated thermal cycles. A reduction of allowable stress is not required for piping that is not expected to experience more than 7000 cycles.

For most non-Class 1 systems at ANO-1, thermal fatigue is not a concern since the system temperatures remain below the thermal fatigue threshold. For the non-Class 1 systems that operate above the temperature threshold for thermal fatigue (alternate AC (AAC) diesel generator system, emergency diesel generator (EDG) system, emergency feedwater (EFW) system, LPI/DHR system, main feedwater system, main steam system, reactor building isolation system), evaluations were performed that indicate that the 7000 cycle fatigue design criteria will not be exceeded during the period of extended operation.

The diesel fire pump exhaust piping operates above the temperature threshold of the fatigue screening criteria. Because this is not ASME qualified piping, the 7000 cycle limit does not apply. For conservatism, cracking from fatigue is considered a potential aging effect for this piping as shown in Table 3.4-2 of the ANO-1 LRA.

(b) **Based on the staff's experience, degradation of mechanical closures, piping systems, and bolted attachments (i.e., loss of integrity of bolted closures, cracking of welds and loosening of bolts) may potentially be caused by vibration (mechanical or hydrodynamic) loading. Appendix C, Section 9.0, of the LRA contains a discussion on the loss of mechanical closure integrity in high vibration applications such as diesel generators. However, it is not clear that cracking of auxiliary system piping welds, especially socket welds, and of ducting in a high vibration environment was considered. Such ducting is in the Auxiliary Building Heating and Ventilation System and the Control Room Ventilation System. In addition, it is not clear that loosening of bolts attaching the base of equipment, such as a fan in the Auxiliary Building Heating and Ventilation System, that is a source of high vibrations has been considered. Identify where in the LRA is high vibration of auxiliary systems piping, duct work, and bolting addressed. If not, perform an AMR of these applications or provide a technical justification for its exclusion from an AMR.**

Consistent with the Oconee position on cracking due to vibrational (mechanical or hydrodynamic) loads as approved by the NRC Staff, Entergy Operations determined that this potential aging effect was not applicable to the ANO-1 auxiliary system components subject to an aging management review. Cracking due to vibration can be attributed to inadequate design. Vibration characteristically leads to cracking in a short period of time, on the order of hours to days of operation. For example, a component with a one Hertz vibratory load will be subjected to 10^7 cycles in four months of service, so that failure is expected early in life for vibratory stresses above the endurance limit. Because this time period is short compared to the overall plant operational life, cracking will be identified and corrected to prevent recurrence long before the period of extended operation. Therefore, cracking due to vibrational loads, both mechanical and hydrodynamic, is not an applicable aging effect for the ANO-1 auxiliary system components subject to an aging management review. Additionally, in Section 3.6.1.3.1 of the Safety Evaluation Report Related to the License Renewal of Oconee Nuclear Station, Units 1, 2 and 3 (NUREG-1723), the following statement is made, "The [NRC] staff concurs with the applicant's assessment and conclusion that vibration is not an applicable aging effect for these [auxiliary systems] piping systems."

As stated in Section 3.4.2 of the ANO-1 LRA, loss of mechanical closure integrity due to high vibration is an applicable aging effect for the skid mounted and connected components of the EDG engine. Additionally, as shown in Tables 3.4-2, 3.4-5, and 3.4-7, loss of mechanical closure integrity due to high vibration is an applicable aging effect for components in the fire protection system, the AAC generator system, and the fuel oil system that are subjected to diesel engine vibration. Loss of mechanical closure integrity due to high vibration was not found to be an applicable aging effect for components in the nine other auxiliary systems.

(c) **The scoping requirements of 10CFR54.4(a)(2) include all nonsafety-related systems, structures, and components whose failure could prevent satisfactory accomplishment of any of the functions identified in paragraphs 10CFR54.4(a)(1)(i). Section 2.1.2 of the LRA, contains a statement that a few cases were identified where non safety-related components could impact safety-related functions and included associated components in the scope of license renewal in accordance with the criteria of 10CFR54.4(a)(2). Please clarify whether the scope of the auxiliary systems discussed in Section 3.4 of the LRA includes any Seismic II/I spatially-related components and piping segments ("Seismic II/I" is a non-seismic Category I system, structure, or component whose failure could cause loss of safety function of a seismic Category I system, structure, or component). Identify where Seismic II/I components and piping segments are specifically included within the scope of license renewal, and identify the**

specific AMPs that apply to these components for each applicable aging effect.

No Seismic Category II/I spatially-related components or piping segments are part of the auxiliary systems within the scope of license renewal as discussed in Section 3.4 of the ANO-1 LRA. At ANO-1, non-seismic Category 1 components are assumed to fail during a seismic event and seismic Category 1 structures are designed to prevent these non-seismic Category 1 components from causing loss of safety function of safety-related components and structures.

As discussed in Section 2.4.3 of the ANO-1 LRA, portions of the ANO-1 auxiliary building contain seismic category 2 structures that have been included within the scope of license renewal per 10CFR54.4(a)(2). Also, as discussed in Section 2.4.6.1 of the LRA, the bulk fuel oil storage tank foundation and the AAC diesel generator building foundation are seismic category 2 structures that have been included within the scope of license renewal. Tables 3.6-4 and 3.6-8 provide a summary of the aging management reviews for these structures, including the specific aging management programs that apply.

(d) Several of the auxiliary systems at ANO-1 may contain piping and components exposed to underground environments. Only two of these systems (fuel oil and service water) have inspection programs listed in Table 3.4 for buried piping. However, it is unclear whether any additional components in any of the auxiliary systems are also exposed to an underground environment. For example, the P&ID for the fire protection system appears to indicate that piping is partially routed in soil or encased in concrete, but an underground environment is not identified in Table 3.4-2. Identify any buried components in any of the auxiliary systems, any applicable aging effects due to an underground environment, and the AMPs that will manage these effects of aging.

In addition to the fuel oil and service water systems, the fire protection system contains buried piping that is within the scope of license renewal. Due to an administrative error in transferring the information from the aging management review report to the ANO-1 LRA, this additional environment for fire protection system piping was omitted. No other auxiliary systems listed in Section 3.4 of the ANO-1 LRA contain buried piping that is within the scope of license renewal.

For the fire protection system, the buried piping is cast iron and carbon steel and serves as a pressure boundary for fire suppression water. This pipe is coated with a primer, a first coat of hot coal tar, a fibrous-glass mat, a second coat of hot coal tar, a wrap of coal tar saturated asbestos felt, and whitewash or Kraft paper. The outside of this pipe is not expected to experience corrosion as long as the coating and wrapping is intact. However, since no inspection program is in place to verify the coating integrity, loss of material is considered to be an applicable aging effect for the external surfaces of the buried piping. The aging management program that will manage this aging effect is the Fire Suppression Water Supply System Surveillance.

3.3.4.3.1-3 **The EDGs and AAC Diesel Generator Systems, diesel generator exhaust components may be susceptible to aging effects such as loss of material from exposure to combustion products. This aging effect is not identified in Appendix C to the LRA. Include loss of material in Appendix C or provide a technical justification for excluding this aging effect as it relates to diesel generator exhaust components.**

Entergy Operations agrees that diesel generator exhaust components are susceptible to loss of material from exposure to combustion products, and this aging effect was determined to be applicable during the conduct of the aging management review of the EDG and AAC diesel generator exhaust systems. Section 3 of the LRA contains the results of the aging management review and is the appropriate place for this information. More specifically, Tables 3.4-3 and 3.4-5 identify loss of material as an applicable aging effect for the exhaust subsystems of the EDG system and the AAC diesel generator system.

3.3.4.3.1-4 **Appendix C, Section 7.0, "Effects Requiring Aging Management in Gas Environments," contains a statement that the internal surfaces of carbon steel components exposed to gas-air and wetted by condensation are susceptible to loss of material. These carbon steel components were said to be found in the following three systems:**

- **Penetration Room Ventilation**
- **Auxiliary Building Heating and Ventilation**
- **Control Room Ventilation**

Tables 3.4-11, 12, and 13 do not identify loss of material as an applicable aging effect for many of the carbon steel components whose surfaces are exposed to a gas-air environment in the Penetration Room Ventilation System, the Auxiliary Building Heating and Ventilation System, and the Control Room Ventilation System, respectively. Identify where in the LRA is the AMR for the loss of

material for these components. If not included in the LRA, provide an AMR for these components, or a technical justification as to why loss of material is not an applicable aging effect for these components.

As indicated in the tables in Section 3 of the LRA, carbon steel components whose internal surfaces are exposed to gas-air are found in the penetration room ventilation system, the auxiliary building heating and ventilation system, and the control room ventilation system. Both the auxiliary building heating and ventilation system and the control room ventilation system contain carbon steel coolers have internal surfaces exposed to gas-air that are wetted by condensation. This is consistent with the information in Tables 3.4-12 and 3.4-13, which identifies loss of material as an applicable aging effect and list the programs that will manage this aging effect. The remaining carbon steel components in these systems do not have their internal surfaces wetted by condensation and loss of material is not an aging effect for these components. In the penetration room ventilation system, carbon steel components whose internal surfaces are exposed to gas-air are not wetted by condensation. This is consistent with the information in Table 3.4-11, which does not list loss of material as an aging effect for the internal surfaces of carbon steel components that are exposed to gas-air.

3.3.4.3.1-5 Tables 3. -11, "Penetration Room Ventilation," and 3.4-13, "Control Room Ventilation," of the LRA, contains a statement that no aging effects apply to tubing and valves of copper, brass and admiralty exposed to an external-ambient environment. However, Section 8.0 of Appendix C, contains a statement that loss of material due to general corrosion applies to these components in ambient environments if the external surface is in contact with moist air. Please identify which statement is correct. If both statements are correct, provide additional explanation to clarify the differences in the statement. In addition, identify which copper, brass, and admiralty components are subject to loss of material from general corrosion to the external surface due to contact with moist air, identify where in the LRA are the AMRs for these components or provide a technical justification for not requiring aging management due to the loss of material for these components.

Both statements are correct. The external surfaces of the instrument tubing and valves made of copper, brass, and admiralty that are exposed to typical internal plant environments (such as the penetration rooms, control room, and other auxiliary building areas) have no applicable aging effect. The external surfaces of copper, brass, and admiralty components that are exposed to adverse (high moisture) ambient environments are subject to loss of material due to general corrosion and require aging management. Since none of the copper, brass, or admiralty components in Tables 3.4-11 and 3.4-13 of the ANO-1 LRA are in a high moisture ambient environment, loss of material is not an applicable aging effect.

3.3.4.3.1-6 Ductwork exists in the Penetration Room Ventilation, Auxiliary Building and Ventilation, and Control Room Ventilation Systems. The ductwork typically includes elastomeric isolators (such as flexible collars between ducts and fans, seals in dampers and doors), which will degrade because of relative motion between vibrating equipment, warm moist air, temperature changes, oxygen, and radiation. Degradation of an elastomer results in hardening and loss of strength. When isolators degrade, vibration and subsequent dynamic loads will be applied to the ductwork and fasteners. Please verify that the ductwork at ANO-1 contains elastomeric insulators. If so, identify where in the LRA are elastomeric insulators addressed or provide a technical justification for not requiring an AMR for these components.

In the penetration room ventilation system, carbon steel expansion joints are provided in the ventilation piping (ductwork) near the inlet and outlet of the ventilation exhaust fans. These expansion joints were subject to an aging management review and the results of the aging management review are provided in Table 3.4-11 of the ANO-1 LRA.

In the auxiliary building and ventilation system and control room ventilation system, ductwork contains flexible expansion joints that join fan housings to the ductwork. These flexible expansion joints are within the scope of license renewal when they are part of components that are within the scope of license renewal. For these systems, flexible expansion joints that are subcomponents of in-scope fan housings are within the scope of license renewal. Preventive maintenance activities are used to manage aging effects on these flexible expansion joints. Specifically, flexible expansion joints are routinely examined by inspections performed in accordance with preventive maintenance procedures. These expansion joints are repaired or replaced when their condition indicates it is no longer acceptable for service. Therefore, these flexible expansion joints are within the scope of license renewal and were subject to an aging management review.

Sealant materials also are used in the ANO-1 penetration room ventilation system, auxiliary building and ventilation system, and control room ventilation system. Sealant materials are within the scope of license renewal when they are part of components or commodities that are within the scope of license renewal and when they are important in maintaining the integrity of the component or commodity. For ventilation system components within the scope of license renewal, preventive maintenance activities are used to manage sealant aging effects. Sealants are routinely examined by inspections performed in accordance with preventive maintenance procedures. The sealant is replaced when its condition indicates it is no longer acceptable for service. Therefore, sealant materials used in the auxiliary building heating and ventilation system are within the scope of license renewal and were subject to an aging management review.

3.3.4.3.1.1-1 **For stainless steel components, the staff's review identified loss of material for stainless steel components in Appendix C, Section 2.0, "Effects Requiring Aging Management in Borated Water Environment," of the LRA, but not for the stainless steel components listed in Table 3.4-1 of the LRA. Identify where in the LRA is the AMR of spent fuel stainless steel components or provide a technical justification for excluding these components from an AMR.**

Loss of material is an applicable aging effect for the stainless steel components exposed to borated water in the spent fuel system. This aging effect should have been listed in Table 3.4-1 of the ANO-1 LRA with the footnote that the aging effect is prevented by the referenced program or activity. Not including this aging effect in this table was an administrative error in compiling the results of the aging management review. The Primary Chemistry Monitoring Program, which is listed in Table 3.4-1, is the aging management program that manages loss of material of the stainless steel in the spent fuel system.

3.3.4.3.1.3-1 **Appendix B, Section 4.21.5, "Emergency Diesel Generator Testing and Inspections," of the LRA does not identify cracking in brass and bronze in the air intake and exhaust subsystem valves as an applicable aging effect, however, Table 3.4-3 of the LRA does identify cracking as an applicable aging effect for these components. Appendix C, Section 7.3.1, "Aging Effects in Air Environment," identifies loss of material caused by several types of corrosion, but does not identify cracking as an applicable aging effect. In addition, loss of material (probably due to corrosion) is listed in Section 4.21.5 but not in Table 3.4-3 of the LRA for copper, brass, or bronze in the air intake and exhaust subsystems valves and the starting air subsystem tubing exposed to gas-air or external-ambient environments.**

(a) Identify an AMP for cracking in brass and bronze for the air intake and exhaust subsystem valves or provide a technical

justification for excluding cracking as an applicable aging effect and correct Table 3.4-3 and the applicable text to reflect the technical justification.

As shown in Table 3.4-3 of the ANO-1 LRA, the Emergency Diesel Generator Testing and Inspections Program described in Section 4.21.5 of Appendix B is the aging management program that addresses cracking of the brass and bronze valves in the EDG air intake and exhaust subsystem. Cracking was inadvertently not included in the list of aging effects addressed by this program in Section 4.21.5 of Appendix B. In the description of the program method in Section 4.21.5 of Appendix B, cracking is identified as an aging effect that would be identified by this program.

(b) **If cracking is determined to be an applicable aging effect in an air environment, include the appropriate discussion under Appendix C, Section 7.3.1.**

The brass and bronze valves in the EDG air intake and exhaust subsystem identified in Table 3.4-3 of the ANO-1 LRA are drain valves that are located in the EDG exhaust piping. Although the internals of these valves are primarily exposed to air, they also may be exposed to water that enters the exhaust piping (such as from rain water) and to EDG exhaust gas constituents such as carbon dioxide, carbon monoxide, nitrogen, water vapor, and unburned hydrocarbons and nitrogen oxide. Because of the potential exposure of the internals of these valves to an aqueous environment with a high level of contaminants (similar to a raw water environment), cracking is an applicable aging effect. Section 4.3.2 of Appendix C identifies that cracking is a potential concern for copper-based alloys in a raw water environment.

(c) **Please verify that the loss of material discussion in Appendix B, Section 4.21.5, is due to corrosion.**

Loss of material of various components in the EDG system, as discussed in Section 4.21.5 of Appendix B of the ANO-1 LRA, is due to one or more types of corrosion.

(d) Include loss of material as an applicable aging effect in Table 3.4-3 and the applicable text for copper, brass, and admiralty in the air intake and exhaust subsystem valves and starting air subsystem tubing.

Because the internal surfaces of the brass and bronze drain valves in the EDG exhaust system may be subject to an aqueous environment with a high level of contaminants (as discussed above), loss of material due to various types of corrosion (e.g., general, pitting, crevice) is an applicable aging effect for the internal surfaces of these valves. Not including this aging effect in Table 3.4-3 of the ANO-1 LRA was an administrative error in compiling the results of the aging management review. The Emergency Diesel Generator Testing and Inspections is the aging management program that manages this loss of material. Because the internal surfaces of the copper tubing in the EDG starting air subsystem are exposed to only dry air, loss of material is not an applicable aging effect for the internal surfaces of this tubing.

3.3.4.3.1.4-1 The following RAIs apply to Table 3.4-4 of the LRA:

(a) Loss of material is not identified as an applicable aging effect in an external ambient environment for carbon steel, brass, bronze and admiralty components in this system. Include loss of material as an applicable aging effect and perform an AMR, or provide a technical justification as to why loss of material is not an applicable aging effect.

The external surfaces of carbon steel components in the auxiliary building sump and reactor building drain system are susceptible to loss of material, due to borated water leakage and the external ambient environment including exposure to sump water. The Boric Acid Corrosion Prevention Program, Local Leak Rate Testing, and the Reactor Coolant Pump (RCP) Oil Leakage Collection System Inspection adequately manage the loss of material aging effect for the external surfaces of these components.

The brass, bronze, and admiralty valves listed in Table 3.4-4 of the ANO-1 LRA are floor drain check valves in the penetration rooms. These valves are mounted in stainless steel drain pipes. The external surfaces, as well as the internal surfaces, can be exposed to the sump water environment. Therefore, the aging effects are the same for internal and external surfaces. Due to administrative errors, the first and fourth rows of Table 3.4-4 are incorrect and should read as follows:

Component Commodity Grouping	Intended Function	Material	Environment	Aging Effect	Program/Activity
Bolting	Pressure boundary	Carbon steel	External-ambient Borated water(1,2) Raw water(2)	Loss of material Loss of mechanical closure integrity	Boric Acid Corrosion Prevention Reactor Building Sump Closeout Inspection Local Leak Rate Testing
Valves	Pressure boundary	Brass Bronze Admiralty	External-ambient Borated water(1,2) Raw water(2)	Loss of material Cracking	Preventive Maintenance

1) Component/system leakage
2) On surfaces wetted by sump water

(b) The second component commodity grouping in Table 3.4-4 is piping, valves, tanks, and bolting made of carbon steel. The environment is borated water and/or oil, with aging effects of loss of material and a loss of mechanical closure integrity. Please clarify whether the environment and aging effects apply to the external or internal surfaces, or both, for these components.

The second commodity grouping in Table 3.4-4 of the ANO-1 LRA is comprised of the components in the reactor coolant pump oil leakage collection system that are subject to an aging management review. The external surfaces of this system, which includes bolting, may be exposed to borated water leakage. Thus, loss of material and loss of mechanical closure integrity are applicable aging effects for the external surfaces of this system. The internal surfaces of this system may be exposed to oil, borated water, or other contaminants that leak into the system. Due to the potential for borated water or other contaminant leakage, loss of material is an applicable aging effect for the internal surfaces of this system.

3.3.4.3.1.5-1 Appendix C, Section 3.3, "Aging Effects in Treated Water Environments," of the LRA, identified loss of material due to pitting as an applicable aging effect for stainless steel in oxygen rich treated water environments. Appendix C, Section 6.3.2, "Lubricating Oil

Environment," also discusses this aging effect in lube oils containing oxygenated water. However, these combinations of aging effects and environments are not identified in Table 3.4-5, "Alternate AC Diesel Generator" of the LRA for stainless steel components. Perform an AMR for loss of material for these combinations of materials and environments or provide a technical justification for determining the loss of material as not being an applicable aging effect.

Loss of material of various stainless steel components in the AAC diesel generator system exposed to gas-air, treated water, and oil is considered an applicable aging effect. Although the internals of the stainless steel valves and expansion joints in the AAC diesel generator exhaust system are primarily exposed to air, they may be exposed to AAC diesel exhaust gas constituents such as carbon dioxide, carbon monoxide, nitrogen, water vapor, and unburned hydrocarbons and nitrogen oxide. Because of the potential for the internals of these components to be exposed to a wetted environment with a high level of contaminants, loss of material due to one or more types of corrosion (e.g., pitting, crevice) is an applicable aging effect for these components and should have been listed in Table 3.4-5 of the ANO-1 LRA. Not including this aging effect in the table was an administrative error. The Alternate AC Diesel Generator Testing and Inspection Program identified in Table 3.4-5 manages this aging effect for these stainless steel components.

Loss of material is an applicable aging effect for the stainless steel valves exposed to lube oil in the AAC diesel generator lube oil subsystem. This aging effect should have been listed in Table 3.4-5 with the footnote that the aging effect is prevented by the referenced program or activity. Not including this aging effect in this table was an administrative error in compiling the results of the aging management review. The Oil Analysis Program, which is listed in Table 3.4-5, is the aging management program that manages loss of material of these stainless steel valves.

Loss of material is an applicable aging effect for the stainless steel valves, thermowells, and expansion joints exposed to treated water in the AAC diesel generator cooling water subsystem. This aging effect should have been listed in Table 3.4-5 with the footnote that the aging effect is prevented by the referenced program or activity. Not including this aging effect in this table was an administrative error in compiling the results of the aging management review. The Auxiliary Systems Chemistry Monitoring Program and the Alternate AC Diesel Generator Testing and Inspection Program, which are listed in Table 3.4-5, are the aging management programs that manage loss of material of these stainless steel components. Because the internal surfaces of the stainless steel piping and valves in the AAC diesel generator starting air subsystem are exposed to dry air, loss of material is not an applicable aging effect for these components.

3.3.4.3.1.6-1 **The only Halon System aging effects identified in Section 3.4.2, "Aging Effects Requiring Management," of the LRA are loss of material and cracking of the discharge tube assemblies and pilot header flexible tubing and fittings due to frequent disconnecting of the equipment. However, Appendix C, Section 7.0, "Effects Requiring Aging Management in Gas Environments," Section 8.0, "Effects Requiring Aging Management in External Surface Environments," and Table 3.4-6, "Halon System," of the LRA, identify all applicable aging effects for Halon System components that require aging management. In addition, Appendix C, Section 7.3.5 contains a statement that Halon is non corrosive to materials in the Halon system. Please provide a clarification by identifying the applicable aging effects, identify the applicable components or component groups, perform an AMR, and provide a demonstration for all applicable aging effects for the Halon System. If any of the aging effects identified as applicable in Appendix C (please specifically address aging effects in Section 7 and Subsection 8.3.1 as well as any other applicable sections) and Table 3.4-6 are identified as being not applicable in the response to this request for clarification, provide a technical justification for this change in LRA information.**

Due to an administrative error in compiling the results of the aging management review, Table 3.4-6 of the ANO-1 LRA is incorrect for the "pipe," "tanks," "discharge nozzles," "discharge tube," and "pilot header discharge tube flexible connectors" component commodity groupings. For the external environment of these component commodity groupings, there is no aging effect because these components are exposed to an indoor, air-conditioned environment. For the internal surfaces of the discharge nozzles, there is no aging effect because aluminum is not susceptible to corrosion or cracking in a gas-halon or gas-nitrogen environment. For the internal surfaces of the discharge tube and the pilot header discharge tube flexible connectors, loss of material and cracking are the applicable aging effects.

Although Section 7.3 of Appendix C of the ANO-1 LRA indicates that halon and nitrogen environments are non-corrosive, these aging effects are not due to the environment (i.e., halon and nitrogen) but are due to wear from frequent manipulations of the components. These aging effects, while not directly attributable to an internal or external environment, are listed with the gas-halon and gas-nitrogen environment. These aging effects are managed by the Control Room Halon Fire System Inspection. This is consistent with the halon system discussion on page 3-53 and the discussion of the Control Room Halon Fire System Inspection on page B-64.

3.3.4.3.1.6-2 **Table 3.4-6, "Halon System," of the LRA identifies loss of material for the gas-Halon and gas-nitrogen (internal) environments for the steel discharge tubes and the stainless steel flexible connectors. However, no aging effects are identified for the internal environments of the steel piping and carbon steel tanks. Provide a technical justification for not identifying loss of material as an applicable aging effect for steel piping and carbon steel tanks that share the same environments and materials as the steel discharge tubes and the stainless steel flexible connectors, respectively.**

In addition, Table 3.4-6 of the LRA, identifies steel and carbon steel as materials used in the Halon system. Specify the kind of steel referred to in this table.

As noted in the RAI response 3.3.4.3.1.6-1, halon and nitrogen environments are non-corrosive. Loss of material of the steel discharge tubes and the stainless steel flexible connectors is caused by wear due to frequent manipulations of these components and not due to corrosion. The steel piping and the carbon steel tanks are not subject to wear from frequent manipulations, and thus loss of material is not an applicable aging effect for these components.

The steel referred to in Table 3.4-6 for the discharge tube and pipe is black or galvanized steel and iron or forged steel, which were evaluated as carbon steel material.

3.3.4.3.1.7-1 **Appendix C of the LRA identifies oxygenated water as an environment that can causing pitting, crevice corrosion, and galvanic corrosion to brass, bronze, copper, stainless steel components leading to loss of material. Table 3.4-7 of the LRA does not identify loss of material as an applicable aging effect for these components. Verify that loss of material is an applicable aging effect for brass, bronze, copper, and stainless steel components. Provide an AMR for loss of material for each of these components, or provide a technical justification for excluding any of these components from an AMR for loss of material.**

Loss of material is an applicable aging effect for brass, bronze, copper, and stainless steel components exposed to a fuel oil environment. This aging effect should have been listed in Table 3.4-7 of the ANO-1 LRA with the footnote that the aging effect is prevented by the referenced program or activity. Not including this aging effect in this table was an administrative error in compiling the results of the aging management review. The Diesel Fuel Monitoring Program, which is listed in Table 3.4-7, is the aging management program that manages loss of material of these brass, bronze, copper, and stainless steel components.

3.3.4.3.1.7-2 Appendix C, Section 6.3.1 of the LRA, identified cracking for stainless steel components exposed to fuel oil. Identify whether or not the tube side or shell side of the stainless steel heat exchanger is not exposed to fuel oil, if so perform an AMR for cracking for this component.

Fuel oil flows through stainless steel tubes in the fuel oil return cooler (heat exchanger). Thus, cracking is an applicable aging effect for the inside of the stainless steel tubes exposed to fuel oil. This aging effect should have been listed in Table 3.4-7 of the ANO-1 LRA with the footnote that the aging effect is prevented by the referenced program or activity. Not including this aging effect in this table was an administrative error in compiling the results of the aging management review. The Diesel Fuel Monitoring Program and the Alternate AC Diesel Generator Testing and Inspections, which are listed in Table 3.4-7, are the aging management programs that manage cracking of the stainless steel tubes.

3.3.4.3.1.8-1 Section 3.4.2, "Aging Effects Requiring Management," of the LRA states that no aging effects were identified for the passive components in the Instrument Air System exposed to dry gases and internal building environments. This is contrary to Appendix C, Section 7.0, "Effects Requiring Aging Management in Gas Environments," and Table 3.4-8, "Instrument Air System," of the LRA, both of which identify aging effects requiring management. Provide a clarification by identifying the applicable aging effects, identify the applicable components or component groups, performing an AMR, and providing a demonstration for all applicable aging effects for the Instrument Air System.

Table 3.4-8 of the ANO-1 LRA identifies the applicable aging effects for instrument air system components subject to an aging management review consistent with Sections 7.3.1 and 8.3 of Appendix C. Section 3.4.2 of the ANO-1 LRA should have indicated that loss of material and cracking are applicable aging effects for the instrument air system. The Instrument Air Quality Program and the Maintenance Rule Program are the aging management programs that manage these aging effects. The Instrument

Air Quality Program ensures that the air in the instrument air system is dry and free of contaminants so that loss of material and cracking of the internal surfaces of components in the instrument air system will not occur. The Maintenance Rule Program ensures that the coatings on the external surfaces of the carbon steel components remain intact so that loss of material of these external surfaces will not occur.

3.3.4.3.1.12-1 Section 9.7.2.1 of the ANO-1 Safety Analysis Report (SAR), contains a statement that the internal surface of the copper tubing of the switchgear room coolers is exposed to chilled water (treated water). Appendix C, Section 3.0, contains a statement that the copper tubing may corrode and pit in a water environment. (Please note that aging occurs in a water environment and that water is treated to manage/prevent the aging. Applicants cannot take credit for chemistry control to prevent aging except as an AMP). However, Table 3.4-12 of the LRA does not listed loss of material as an applicable aging effect for the internal surface of the tubing exposed to chilled water. Identify where in the LRA is aging of the switchgear room coolers copper tubing addressed or provide a technical justification for excluding loss of material as an applicable aging effect for these components.

The internal surface of the copper tubing of the switchgear room coolers is exposed to chilled water and aging management of this surface is addressed as part of the review of the chilled water system in Table 3.4-9 of the ANO-1 LRA. Loss of material is an applicable aging effect for the internal surface of this copper tubing since it is exposed to treated water. The Auxiliary Systems Water Chemistry Monitoring Program manages this aging effect.

The external surface of the copper tubing of the switchgear room coolers forms a part of the pressure boundary of the auxiliary building heating and ventilation system, and aging management of this surface is addressed as part of the review of this system in Table 3.4-12.

3.3.4.3.2-1 **The request for additional information identified below resulted from the staff's evaluation of the Preventive Maintenance Program used as an AMP to manage the loss of material and apply to components in the following systems:**

- **Fire Protection System**
- **Auxiliary Building Heating and Ventilation**
- **Control Room Ventilation**

(a) Section 3.4.3 of the LRA contains a statement that the Preventive Maintenance Program applies to the Auxiliary Building Ventilation System, the fuel oil system, and the Control Room Ventilation System. However, Table 3.4-2 of the LRA, shows preventive maintenance as an AMP for the Fire Protection System. Conversely, Table 3.4-7 of the LRA, does not show the Preventive Maintenance Program as an AMP for the Fuel Oil System. Please clarify the scope and applicability of the Preventive Maintenance Program to the systems and components in Appendix B, Section 4.15 and Tables 3.4-1 through 3.4-13, of the LRA.

The Preventive Maintenance Program applies to the following auxiliary systems:

- Fire Protection System (Table 3.4-2)
- Fuel Oil System (Table 3.4-7)
- Auxiliary Building Heating and Ventilation (Table 3.4-12)
- Control Room Ventilation System (Table 3.4-13)

The "Preventive Maintenance Program" bullet of Section 3.4.3 of the ANO-1 LRA (page 3-55) should have included the "Fire Protection System."

Due to an administrative error, Table 3.4-7 on the fuel oil system should credit the Preventative Maintenance Program for tank inspections to be consistent with the results of the aging management review.

(b) Please identify the parameters to be monitored or inspected for the applicable components in Table 3.4 of the LRA under the Preventive Maintenance Program. Show that these parameters are associated with the degradation of the components' intended functions. Demonstrate that the visual inspections performed during walk-downs are adequate for detecting aging effects on surfaces that may not be easily accessible.

As stated in the previous response, the Preventive Maintenance Program applies to the following systems:

- Fire Protection System (Table 3.4-2)
- Fuel Oil System (Table 3.4-7)
- Auxiliary Building Heating and Ventilation (Table 3.4-12)
- Control Room Ventilation System (Table 3.4-13)

The components inspected for these systems under the Preventive Maintenance Program, along with the parameters that are observed, are as follows:

- Fire Protection System (Table 3.4-2)

  Procedures require visual inspection of the following diesel fire pump engine (K5) components: air cleaner and hoses, oil filter and oil filter hoses, turbocharger, water pump and coolant hoses. Parameters observed are loose clamps, cracks, punctures and tears. Corrective actions are completed in accordance with the site corrective action program as necessary. Bolt torque is checked as required to ensure bolted closure integrity. This maintenance will detect loss of material or cracking of these components and help to prevent a loss of bolted closure integrity.

- Fuel Oil System (Table 3.4-7)

  Preventive maintenance tasks drain and clean the safety related fuel oil tanks every 10 years to ensure there is no sludge buildup. These tasks will be updated to have the coating inspected to ensure it is intact (no flaking or any observable damage to coating) and the uncoated areas of the tank internal surfaces inspected for corrosion. These activities will detect loss of material. Section 4.15 of Appendix B of the ANO-1 LRA indicates that these new activities will be incorporated into existing preventive maintenance procedures prior to the end of the initial 40-year license term for ANO-1.

- Auxiliary Building Heating and Ventilation (Table 3.4-12)

  The preventive maintenance activities listed below currently ensure the cooling coils are clean and thus detect whether fouling is occurring. The activities will be modified to specifically document an inspection for loss of material. Section 4.15 of Appendix B indicates that these new activities will be incorporated into existing preventive maintenance procedures prior to the end of the initial 40-year license term for ANO-1.

- Repetitive Work Tasks

  - Cleaning and inspection of VEF-24A/B/C/D exhaust ventilation penthouse assemblies and the portions of the intakes that could be wetted by rain.
  - Cleaning and inspection of VUC-1A/B/C/D cooling coil and housing assemblies
  - Cleaning and inspection of VUC-2B/2D cooling coil and housing assemblies
  - Cleaning and inspection of VUC-7A/B/C cooling coil and housing assemblies
  - Cleaning and inspection of VUC-14A/B/C/D cooling coil and housing assemblies

- Control Room Ventilation System (Table 3.4-13)

  The preventative maintenance tasks for 2VUC-27A and 2VUC-27B currently ensure the cooling coils are clean and thus detect whether fouling is occurring. The tasks will be modified to specifically document an inspection for loss of material. Section 4.15 of Appendix B indicates that these new activities will be incorporated into existing preventive maintenance procedures prior to the end of the initial 40-year license term for ANO-1.

The aging management review did not identify any unique aging effects for inaccessible surfaces of components that are subject to visual inspections. Thus, inspection of the surfaces in the accessible areas is a representative sample of both accessible and inaccessible surfaces. When an unacceptable condition or situation is identified for an accessible surface of a component, a determination will be made as to whether the same condition or situation is applicable to other accessible or inaccessible surfaces of the component or other components, and what additional actions need to be taken.

(c) **Please describe how the activities in the Preventive Maintenance Program would detect aging effects before there is a loss of function for the applicable components consistent with the CLB in Table 3.4 of the LRA. Discuss the approach to sampling, if applicable, and the frequencies of the activities performed. Describe monitoring and trending activities to show that they would predict the extent of degradation and allow timely corrective or mitigative actions.**

The response to part (b) of this RAI describes the auxiliary system components that are inspected by the Preventive Maintenance Program and the inspection activities that are performed. How the Preventive Maintenance Program would detect aging effects for these components before there is a loss of function is discussed below.

- Fire Protection System (Table 3.4-2)

  For the diesel fire pump engine (K5), inspections are used to identify loss of material, cracking, or loss of mechanical closure integrity of air cleaner and hoses, oil filter and oil filter hoses, turbocharger, water pump, or coolant hoses. Inspections of these components are performed at least once every year. These inspections are visual. If aging effects are identified during these inspections, a condition report is prepared and appropriate corrective actions are taken in accordance with the site corrective action program. Based on plant operating history, this preventive maintenance activity in concert with the Fire Suppression Water Supply System Surveillance is sufficient to detect aging effects for the diesel fire pump components before there is a loss of function.

- Fuel Oil System (Table 3.4-7)

  A visual inspection of the internal surface of the safety related fuel oil tanks indicates if loss of material is occurring. These inspections are performed every 10 years. When defects are identified, condition reports are prepared, defects are evaluated, and corrective actions are taken, as necessary, in accordance with the site corrective action program. Based on plant operating history, this preventive maintenance activity in concert with the Diesel Fuel Monitoring Program is sufficient to detect aging effects for the safety-related fuel oil tanks before there is a loss of function.

- Auxiliary Building Heating and Ventilation (Table 3.4-12)

  Inspection of the ventilation components listed in the response to part (b) of this RAI indicates if loss of material or fouling is occurring. Visual inspections of these components are performed at least once every two years. When defects are identified, condition reports are prepared, defects are evaluated, and corrective actions are taken, as necessary, which may include monitoring and trending. Based on plant operating history, this preventive maintenance activity is sufficient to detect aging effects for these ventilation components before there is a loss of function.

- Control Room Ventilation System (Table 3.4-13)

  Inspection of 2VUC27A and 2VUC27B indicates if loss of material or fouling is occurring. Visual inspections of these components are performed at least once every two years. When defects are identified, condition reports are prepared, defects are evaluated, and corrective actions are taken, as necessary, which may include monitoring and trending. Based on plant operating history, this preventive maintenance activity in concert with Control Room Ventilation Testing is sufficient to detect aging effects for these ventilation components before there is a loss of function.

(d) Please describe the acceptance criteria and methodology used to analyze results of the inspection and testing under the Preventive Maintenance Program for the applicable components in Table 3.4 of the LRA. The description of the program contains a statement that if existing preventive maintenance procedures do not have adequate inspection criteria for aging effects, but they will be updated to provide appropriate criteria before the end of the current 40-year license term. Additional information is needed for the staff to adequately assess the Preventive Maintenance Program. Identify the inspection criteria that are in question and provide a discussion that will help the staff to understand the basis for the criteria that will be developed.

The preventive maintenance inspections for auxiliary system components are visual inspections. The acceptance criteria for these inspections are no unacceptable visual indications of cracking, loss of material, loss of mechanical closure integrity, or fouling depending on the component being inspected. If unacceptable visual indications are identified, a condition report is prepared and appropriate corrective actions are taken, which may include additional monitoring or trending. These preventive maintenance activities will be monitored for effectiveness via ongoing maintenance assessment activities and enhancements will be made if warranted.

As indicated in the response to part (b) of this RAI, some of the preventive maintenance activities for the auxiliary system components subject to aging management review need to be updated to include inspections for loss of material. The acceptance criteria for these new inspections will be no unacceptable visual indications of loss of material.

(e) **Provide a summary description of the operating experience associated with the Maintenance Rule Program as it specifically applies to the components in Table 3.4 of the LRA, that will demonstrate that this program will effectively manage the applicable aging effects. (Refer to Nuclear Energy Institute (NEI) 95-10, Revision 0, page C-8 for an example of the kind of operating history used in a demonstration.)**

For the auxiliary system components listed in the tables of Section 3.4 of the ANO-1 LRA, the Maintenance Rule Program is used to manage loss of material of external surfaces and loss of mechanical closure integrity. More specifically, the Maintenance Rule Program is used to verify that the coated surfaces of these components, including bolting, remain intact so that the material under the coating will not corrode. These verifications are performed during component walk-downs using visual inspections. The ANO-1 history of successful operation demonstrates that visual inspections have been effective in managing the effects of aging on structures and components. Specifically, visual inspections have been shown to identify coating degradation. Thus, based on this experience, the visual inspections performed during component walk-downs will be effective in the future for verifying coating integrity, especially since the inspections incorporate a proven monitoring technique, acceptance criteria, corrective actions, and administrative controls from existing programs and procedures.

3.3.4.3.2-2 The request for additional information listed below resulted from the staff's evaluation of the Preventive Maintenance Program used as an AMP to manage fouling and applies to components in the following systems:

- **Auxiliary Building Heating and Ventilation**
- **Control Room Ventilation**

Respond to each of the following requests, addressing each system specifically.

(a) Please describe the inspection and cleaning process used to ensure that not even a thin film of fouling, that can impact the heat transfer function (reference Appendix C, Section 10), exist on the tube surface. Include in your discussion the means, including any criteria, by which fouling is verified not to exist.

Cleaning of the cooling coils involves spraying the coils using a solvent, allowing the solvent to stand on the coils for a period of time, and rinsing the coils with clean fresh water. The solvent is reapplied as necessary until the desired cleanliness is achieved. Visual inspections of the coils are performed to ensure there are no unacceptable indications of fouling. ANO-1 operating experience has shown that this inspection and cleaning process is effective in managing fouling. Visual inspections are employed under the current licensing basis for managing fouling in air to service water heat exchangers. See the ANO correspondence on Revised Approach for Compliance to NRC Generic Letter 89-13; Service Water, dated October 30, 1992 (0CAN109205).

(b) Please identify the frequencies for the copper tubing inspection and cleaning activities and/or how they are determined. Demonstrate that fouling of the copper tubing will be detected in a timely manner.

The preventive maintenance cleaning and inspection activities for the ventilation cooling coils are typically performed at least once every two years. ANO-1 operating experience has shown that this frequency is effective in managing fouling.

(c) The program description contains a statement that if existing preventive maintenance procedures do not have adequate inspection criteria for aging effects, they will be updated to provide appropriate criteria before the end of the current 40-year license term. Additional information is needed for the staff to adequately assess the Preventive Maintenance Program. Identify

the inspection criteria that are in question and provide a discussion that will help the staff to understand the basis for the criteria that will be developed.

The inspection criteria in question are those related to inspection for loss of material. The criteria are expected to be no unacceptable visual indications of loss of material, such as caused by corrosion or mechanical wear. See the RAI response 3.3.4.3.2-1(d), which addresses the acceptance criteria for preventive maintenance related to auxiliary system components.

(d) **Provide a summary description of the operating experience associated with the Preventive Maintenance Program as it specifically applies to the components in Table 3.4 of the LRA, that will demonstrate that this program will effectively manage the applicable aging effects. (Refer to NEI 95-10, Revision 0, page C-8 for an example of the kind of operating history used in a demonstration.)**

Preventive maintenance activities associated with auxiliary system components involve visual inspections of components and coatings, cleaning, and verifying bolt torque. These activities are used to manage loss of material, loss of mechanical closure integrity, and fouling. These types of preventive maintenance activities have been shown effective throughout the industry and have been accepted under the current licensing basis for managing the effects of aging on components. Specifically, visual inspections have been shown to identify material and coating degradation and fouling of heat exchangers. Cleaning has been shown effective in minimizing the effects of fouling. Verifying bolt torque has been proven as a means for ensuring mechanical closure integrity. Thus, based on this experience, the Preventive Maintenance Program will be effective in the future for managing loss of material, loss of mechanical closure integrity, and fouling since it consists of proven monitoring techniques, acceptance criteria, corrective actions, and administrative controls in existing programs and procedures.

3.3.4.3.2-3 The request for additional information listed below resulted from the staff's evaluation of the Oil Analysis Program used as an AMP to manage the loss of material and cracking, and apply to components in the following systems:

- **Fire Protection System**
- **Emergency Diesel Generator**

- **AAC Diesel Generator**
- **Chilled Water**
- **Control Room Ventilation**

(a) Tables 3.4-2, 3.4-3, 3.4-5, and 3.4-9, contain statements that components of several materials (e.g., carbon steel, cast iron, brass, Aluminum, admiralty, and stainless steel) are exposed to a lube oil environment, but identify cracking as an applicable aging effect only for stainless steel components. Provide a justification for excluding cracking as an applicable aging effect for carbon steel, cast iron, brass, aluminum, and admiralty.

Appendix C of the ANO-1 LRA, "Process for Identifying Aging Effects Requiring Aging Management for Non-Class 1 Mechanical Components", states in Section 6.3.2, "Lubricating Oil Environment":

"Cracking due to stress corrosion of the stainless steel material in a lubricating oil environment is an applicable aging effect at locations containing oxygenated water."

Cracking is not identified as an aging effect for any other materials in this environment. Industry and ANO-1 operating history also have shown that cracking of carbon steel, cast iron, brass, aluminum, and admiralty in a lube oil environment is not a concern.

(b) Provide a summary description of the Oil Analysis Program that includes a discussion on how measuring particulate in an oil sample is used to detect a loss of material or cracking in a specific component. Describe any monitoring and trending activities that would assist in maintaining the CLB with respect to minimum wall thickness or allowable cracking, and allow timely corrective actions for components exposed to lube oil. In addition, describe any acceptance criteria, and its bases, for the oil analysis activities listed in Appendix B, Section 4.14, of the LRA. Include the method(s) used to analyze the results of the tests performed.

The Oil Analysis Program is a preventive program. As stated in Section 4.14 of Appendix B, the Oil Analysis Program maintains oil systems free of contaminants (primarily water and particulates) thereby preserving an environment that is not conducive to corrosion. By maintaining a non-corrosive environment, the program manages the effects of cracking and loss of material.

In analyzing oil samples, the Oil Analysis Program may identify a high level of particulates, which may indicate that a loss of material occurred. If a high level of particulates is identified in an oil sample, the cause is identified and appropriate corrective actions are taken. The ability of the Oil Analysis Program to possibly detect loss of material of a component is not credited as a function of this aging management program.

Specific acceptance criteria for the Oil Analysis Program are contained in site procedures. Particle concentration limits are based on SAE749D Class 6 oils for all components except the EFW turbines, which are based on SAE Class 3. Water concentration limits are based on the CRC Handbook of Lubrication definition of trace amount (0.1%). Viscosity bands are based on a tolerance of 10% around base viscosity. Metal limits by spectral analysis are based on technical manuals.

Methods that are used in analyzing oil samples include visual inspection, titration, distillation, particle count method, spectral analysis, and the standard method for determining kinematic viscosity. The specific methods that are used depend on the oil sample and whether the initial evaluation of the oil sample (exceeding a limit) indicates the need for additional analyses to be performed.

(c) **Appendix B, Section 4.14, "Oil Analysis," of the LRA, addresses operating experience regarding excess water in the oil, but not particulates. Provide a summary description of the operating experience associated with the Oil Analysis Program as it specifically applies to the components in Table 3.4 of the LRA, that will demonstrate that this program will effectively manage the applicable aging effects. (Refer to NEI 95-10, Revision 0, page C-8 for an example of the kind of operating history used in a demonstration.) Include in your description, the operating experience associated with the presence of water and particulate in oil samples.**

Due to an administrative error, the statement in the LRA should have been, "Review of historical oil sampling plots for components in the scope of license renewal verifies that the lubricating oil is maintained free of excess water and contaminants." Entergy Operations has collected historical data of oil analysis results since 1990 for components in the scope of license renewal. The results show these components are maintained free of excess water in the oil, contamination that impacts oil acidity is not occurring, and adequate levels of additives remain in the oil to neutralize any acid that forms during engine operation. This historical data demonstrates that the oil for components in the scope of license renewal is maintained free of excess water or contaminants.

3.3.4.3.2-4 The request for additional information listed below resulted from the staff's evaluation of the Heat Exchanger Monitoring Program used as an AMP to manage the loss of material, fouling, and cracking, and apply to components in the following systems:

- **Chilled Water**
- **Service Water**

For the applicable components in Table 3.4-9 and 3.4-10 of the LRA:

(a) Describe the preventive and mitigative actions and how these actions would mitigate or prevent aging degradation.

The Heat Exchanger Monitoring Program is a mitigation and detection program that manages loss of material and cracking. This program is not credited for managing fouling. The inspection methods to be used in the Heat Exchanger Monitoring Program include non-destructive examinations, specifically eddy current inspections and visual inspections. Eddy current inspections and visual inspections have been demonstrated to be effective in detecting aging effects. The methods that will be used are consistent with industry practices that have been commonly accepted by the NRC Staff.

(b) Identify the parameters monitored or inspected and describe how these parameters are associated with the degradation of the components' intended functions.

The Heat Exchanger Monitoring Program will include eddy current inspections on the shell-and-tube heat exchangers. The aging effects being managed by this program for the tubes are loss of material and cracking. The eddy current inspections will reveal such tube degradation. The Heat Exchanger Monitoring Program will provide for internal visual inspections of heat exchanger heads, covers and tubesheets where accessible. Visual inspections are effective in determining evidence of degradation, which could result from loss of material. The intended function being maintained by this program is pressure boundary.

(c) Describe how the inspection activities would detect the applicable aging effects before the loss of function; describe any monitoring and trending activities that would assist in maintaining the CLB with respect to the applicable intended functions, and allow for

timely corrective or mitigative actions for the components exposed to lube.

The eddy current inspections of the shell-and-tube heat exchangers will consist of a sample inspection of the heat exchanger tubes to identify degraded conditions. The inspection frequency will be every ten years or more frequently if inspection results indicate a need for more frequent inspections. The tubes with wall loss measured at greater than 60% through-wall will be plugged or evaluated to justify continuing service. No trending activities are required since the inspection criteria are based on maintaining the intended function between inspection intervals. The visual inspections of the accessible heat exchanger heads, covers and tubesheets will be performed on the same frequency as the eddy current inspections.

(d) Identify any acceptance criteria, its basis, and the methodology used to analyze results of the inspection and testing activities.

The acceptance criterion for the tube eddy current inspections is wall loss less than 60% through-wall. This follows industry practice that considers 60% wall loss a conservative standard for requiring further evaluation and possible corrective action. The Staff, in NUREG-1723, found this acceptance criterion for eddy current testing of heat exchanger tubes reasonable because it is conservatively based on a combination of code requirements and industry practice.

The acceptance criterion for the visual inspections of the heat exchanger heads, covers and tubesheets is 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 process.

(e) Provide a summary description of the operating experience associated with the Heat Exchanger Monitoring Program as it specifically applies to the components in Tables 3.4-9 and 3.4-10 of the LRA, that will demonstrate that this program will effectively manage the applicable aging effects. (Refer to NEI 95-10, Revision 0, page C-8 for an example of the kind of operating history used in a demonstration.)

The Heat Exchanger Monitoring Program is a new program and thus has no operating experience. Eddy current inspections and heat exchanger internal visual inspections are standard industry methods to manage aging effects in heat exchangers. The methods that will be used are consistent with industry practices that have been commonly accepted by the NRC Staff. The eddy current inspections and visual inspections in this program are similar to those described for similar heat exchangers in the license renewal applications for Oconee and Calvert Cliffs.

3.3.4.3.2-5 The RAI listed below resulted from the staff's evaluation of the EDG Testing and Inspection Programs used as an AMP to manage the loss of material, and apply to the components in the following systems:

- **Emergency Diesel Generator**
- **Auxiliary Building Heating and Ventilation**
- **Fuel Oil**

Provide a summary description of the operating experience associated with the EDG Testing and Inspection Program as it specifically applies to the components in Tables 3.4-3, 3.4-7 and 3.4-12 of the LRA, that will demonstrate that this program will effectively manage the applicable aging effects. (Refer to NEI 95-10, Revision 0, page C-8 for an example of the kind of operating history used in a demonstration.)

The Emergency Diesel Generator Testing and Inspection Program has proven effective in managing loss of material in components in the EDG system, the auxiliary building heating and ventilation system and the fuel oil system. To confirm this conclusion for the exhaust subsystem, an inspection was performed. Visual inspections as well as ultrasonic test measurements were utilized. The areas chosen for UT measurements were the areas most likely to trap or store water, the discharge elbow and the underside of the silencer. The visual inspections as well as UT measurements indicated little or no thinning or pitting exists from the operation of the units for approximately 20 years. This inspection has therefore shown there is no significant loss of material and the inspections of the engine and exhaust performed as a part of the ANO-1 Technical Specification maintenance are adequate to manage these limited effects on the internal surfaces of the exhaust subsystem.

Testing and Inspection detected degradation of the starting air subsystem. Consequently, modifications were performed which replaced the air compressor, receiver tanks, aftercooler, air dryer, piping and components.

Based on a review of industry experience and ANO-1 condition reports regarding the EDGs, these tests and inspections provide reasonable assurance that the aging effects will be managed such that the EDGs will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

3.3.4.3.2-6 The request for additional information listed below resulted from the staff's evaluation of the Auxiliary System Water Chemistry Program used as an AMP to manage the loss of material, and cracking, and apply to components in the following systems:

- **Emergency Diesel Generator**
- **AAC Diesel Generator**
- **Chilled Water**

Respond to each of the following requests, addressing each system specifically.

a. **Tables 3.4-3, 3.4-5, and 3.4-9 of the LRA list components in gas-air, gas-freon and lube oil environments as managed by the Auxiliary Systems Water Chemistry Monitoring Program. The Auxiliary System Water Chemistry Program maintains the water chemistry of primarily the Service Water System that interface with these systems and is not used for gas-air, gas-freon and lube oil environments. Discuss why the tables in question show the Auxiliary System Water Chemistry Program used for managing aging associated with gas-air, gas-freon or lube oil environments.**

In Table 3.4-3 of the ANO-1 LRA, the listing of the Auxiliary Systems Water Chemistry Monitoring as a program for managing fouling in a gas-air or lube oil environment was an administrative error. In Tables 3.4-5 and 3.4-9, environments for inside and outside of the heat exchanger tubes are listed in the same row of the tables. The Auxiliary Systems Water Chemistry Monitoring in these tables was intended to apply only to the treated water environment of the heat exchangers. It does not apply to the gas-air or gas-freon environment.

3.3.4.3.2-7 The requests listed below result from the Buried Piping Inspection program to manage loss of material and apply to components in the following systems:

- **Fuel Oil**
- **Service Water**

Respond to each of the following requests, addressing each system specifically.

(a) In previous LRAs, the AMPs used to mitigate the effects of aging to underground piping included cathodic protection. Based on the industry experience and a review of technical material, the staff believes that cathodic protection is necessary for adequate aging of underground piping. Provide detailed operating experience that will adequately demonstrate the effectiveness of managing the aging of underground piping without the benefits of cathodic protection, or provide additional means of preventing and/or monitoring the aging of underground piping.

The cathodic protection of buried piping is provided by the nonsafety-related cathodic protection system. The cathodic protection system is not within the scope of license renewal because it does not perform any of the system intended functions defined by 10CFR54.4(a)(1), 10CFR54.4(a)(2), or 10CFR54.4(a)(3). Evidence of coating perforation or damage and evidence of pipe damage will be evaluated in accordance with the site corrective action program. The corrective action program implements the requirements of 10CFR Part 50 (Appendix B), and contains provisions for repair or replacement, determining the root cause, assessing generic implications, and implementing actions to prevent recurrence.

(b) The Buried Piping Inspection program will be used to perform initial inspections when underground piping is uncovered during plant maintenance or modification. State the extent and how often underground piping is expected to be uncovered for modification and maintenance. Be sure to include the maximum period of time between inspection and a justification for the adequacy of the inspection frequency.

If defective coating or loss of material is found, further sampling of underground piping would be warranted. Describe the method and criteria that will be used to determine the number of additional inspection sites, their locations and frequencies of inspection. Submit this information in sufficient detail to allow the staff to determine whether the approach to determining the locations and frequencies of additional inspections will provide reasonable assurance that the loss of material will be identified before the integrity of the pressure boundary of the buried piping is compromised.

The buried piping inspection program is intended to verify that the external coatings remain intact and are adequately protecting the buried piping from aging effects. Operating experience has shown that buried piping coatings are effective barriers to prevent aging. Since the process of excavation of buried piping for inspection would increase the possibility of damage to the coatings, this inspection program does not include scheduled excavation solely for inspection. In the past, maintenance activities requiring excavation include repairs of underground domestic water line leak, service water line leak, and fuel oil line leak. For example, in 1995, a fuel oil line leak occurred and a 20' x 10' x10' area was excavated to locate the source of the leak. The cause of the leak was determine to be an acid spill that was localized around an abandoned acid line, which was located near the buried fuel oil line. During the maintenance activity, a 20' section of the buried piping was inspected and two additional areas of damaged tar coating were observed (due to the acid exposure). These areas were cleaned, buffed, and new tar coating was applied. No other evidence of degraded coatings was noted.

In summary, the buried piping inspection program will be based on random excavations associated with required maintenance activities, usually to facilitate repairs. These are not scheduled activities. Based on past experience, it is estimated that sections of buried piping will be excavated every five to ten years. If defective coatings or loss of material are found during these excavation activities, the corrective action program will be utilized to determine the need for and scope of additional inspections, the actions needed to correct the identified problem, and any actions needed to prevent reoccurrence of the problem.

(c) **The Buried Pipe Inspection Program demonstration contains a statement that the program *"will be effective in the future for managing aging effects since it incorporates proven monitoring techniques, acceptance criteria, corrective actions and administrative***

controls from existing programs and activities." **Provide a basis for the statement that the program incorporates "proven" monitoring techniques, acceptance criteria, corrective actions and administrative controls.**

The Buried Piping Inspection Program will be effective because:

(1) coating, wrapping, and cathodic protection have been demonstrated in this and many other industries to be effective at mitigating corrosion by inhibiting environmental effects;
(2) degradation of the exterior carbon steel surfaces cannot occur without degradation of or damage to the coating and wrapping and, thus, inspecting and confirming that the coating and wrapping are intact is an effective method of ensuring that corrosion on external surfaces does not occur and the intended function is maintained;
(3) effects of corrosion are detectable by visual inspection; and
(4) acceptance criteria ensure that coating and wrapping degradations would be reported and evaluated according to the site corrective action program.

3.3.4.3.2-8 The requests listed below result from the evaluation of the Reactor Building Leak Rate Testing Program and apply to components in the following systems:

- **Spent Fuel System**
- **Fire Protection System**
- **Auxiliary Building Sump and Reactor Building Drain**
- **Chilled Water**

Respond to each of the following requests, addressing each system specifically.

(a) Verify that each AMP in each of the rows apply to each of the aging effects in the same row unless indicated by excessive spaces and alignment of aging effects with AMPs throughout the tables in Section 3 of the LRA. Reference the last row in Table 3.4-2.

The aging management programs listed in each row of the subject tables were intended to apply to the aging effects in the same row. In response to this RAI, the subject tables were reviewed again to determine if any corrections were needed. As a result, the following change to Table 3.4-2 was identified. Only Table 3.4-2 required correction.

Table 3.4-2 Fire Protection System					
Component Commodity Grouping	Intended Function	Material	Environment	Aging Effect	Program/ Activity
Heat Exchangers	Heat Transfer	90/10 Cu-Ni Copper	Treated Water(2)	Fouling	Fire Suppression Water Supply System Surveillance
			Lube Oil(3)(1)	Fouling	Oil Analysis

1) Aging effect prevented by referenced program or activity
2) Inside of tubes
3) Outside of tubes

(b) Provide the following information for the applicable components of Table 3.4 that use the Reactor Building Leak Test Rate Testing program:

1. **Identify the parameters to be monitored or inspected and show that these parameters are associated with the degradation of the components' intended functions.**

2. **Describe how the activities would detect aging effects before there is a loss of function; describe the monitoring and trending activities; describe how these activities would predict the extent of degradation and allow timely corrective or mitigative actions; and describe the acceptance criteria and the methodology used to analyze results of the inspection and testing.**

The parameter monitored in the Integrated Leak Rate Test is reactor building leak rate. Degradation of a component could result in leakage in excess of that permitted. The parameter monitored in the Local Leak Rate Test is leakage rate. Degradation of a component could result in leakage in excess of that permitted. Leakage in excess of that permitted would be evaluated and resolved under the site corrective action program.

This testing exposes the penetrations to the maximum pressure expected under accident conditions and then checks for leakage to verify penetration integrity. This testing would help to identify system leakage and is credited as one of the methods of managing the aging effect of loss of material from boric acid corrosion. This testing would not detect cracking or loss of material that had not yet resulted in pressure boundary leakage. Therefore, the Reactor

Building Leak Rate Testing Program is used in conjunction with other programs to manage the aging effects of those particular components. Table 3.4 of the ANO-1 LRA lists the other programs used to manage the applicable aging effects.

The Reactor Building Leak Rate Testing Program is an NRC approved program that is part of the ANO-1 current licensing basis and is implemented in accordance with ANO-1 Technical Specification 6.8.4. This program is similar to the Containment Leak Rate Testing Program approved by the NRC in NUREG-1723, Safety Evaluation Report Related to the License Renewal of Oconee Nuclear Station, Units 1, 2, and 3.

(c) **Provide a summary description of the operating experience associated with the Reactor Building Leak Rate Testing Program as it specifically applies to the components in Tables 3.4-2, 3.4-4, and 3.4-9 of the LRA, that will adequately demonstrate that this program will effectively manage the applicable aging effects during the period of extended operation.**

As stated in Appendix B of the ANO-1 LRA, historically, leakage rates have been well within the maximum allowable leakage rates specified in the technical specifications. If maintenance is required on a valve because of leakage in excess of acceptable limits, an additional leak rate test is performed to confirm the adequacy of the maintenance. The continued implementation of leak rate testing, in conjunction with other credited programs, provides reasonable assurance that the aging effects will be managed such that containment isolation components in the spent fuel system, fire protection system, auxiliary building sump and reactor building drain system, and chilled water system will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

3.3.4.3.2-9 The requests listed below result from the evaluation of the Maintenance Rule Program and apply to components in the following eleven systems:

- **Fire Protection System**
- **Emergency Diesel Generator**
- **AAC Diesel Generator**
- **Halon**
- **Fuel Oil**
- **Instrument Air**
- **Chilled Water**

- **Service Water**
- **Penetration Room Ventilation**
- **Auxiliary Building Heating and Ventilation**
- **Control Room Ventilation**

Respond to each of the following requests, addressing each system specifically.

(a) Section 3.4.3 of the LRA, contains a statement that the Maintenance Rule Program will ensure piping and component integrity is maintained in the following systems: fuel oil, chill water, penetration room ventilation, auxiliary building heating and ventilation, AAC generator and wetted portions of the EDG exhaust; the other five systems are not included. However, in Table 3.4 of the LRA, the Maintenance Rule Program is credited for managing aging in all eleven systems. Clarify the scope and applicability of the Maintenance Rule Program for the eleven systems noted above and components in Appendix B, Section 4.13, of the LRA, and in Tables 3.4-1 through 3.4-13. Provide this information on a system specific basis. Additionally, reconcile the component listings and intended functions shown in the LRA Tables 3.6-1 through 3.6-8 with those listed in the applicable Tables from 3.4-1 through 3.4-13.

The Maintenance Rule Program applies to the aging management review of the following systems:

- Fire Protection System (Table 3.4-2)
- Emergency Diesel Generator System (Table 3.4-3)
- AAC Diesel Generator System (Table 3.4-5)
- Fuel Oil System (Table 3.4-7)
- Instrument Air System (Table 3.4-8)
- Chilled Water System (Table 3.4-9)
- Service Water System (Table 3.4-10)
- Penetration Room Ventilation System (Table 3.4-11)
- Auxiliary Building Heating and Ventilation (Table 3.4-12)
- Control Room Ventilation System (Table 3.4-13)

For these ten systems, the Maintenance Rule Program is credited for monitoring coatings on carbon steel and cast iron external surfaces to manage the aging effect of loss of material. As discussed in RAI response 3.3.4.3.1.6-1, the Maintenance Rule Program is not credited for Halon system components subject to an aging management review.

The Fire Protection, Instrument Air, Service Water and Control Room Ventilation Systems should have been listed under the Maintenance Rule Program bullet of Section 3.4.3 of the ANO-1 LRA (page 3-54). This was an administrative error in compiling the results of the aging management review.

Tables 3.6-1 through 3.6-8 address structures and structural commodities. The tables in Section 3.4 address mechanical components. As such, the intended functions are different between the tables in the two sections.

(b) Appendix B, Section 4.13, does not list the Maintenance Rule Program as an AMP for "loss of mechanical closure integrity". However, in several sections of Table 3.4 (e.g., Tables 3.4-3 and 3.4-9) of the LRA , the Maintenance Rule Program is credited for managing mechanical closure integrity for several components. Please provide the correct information in response to this question.

For mechanical systems, the Maintenance Rule Program manages the aging effect of loss of material. Significant loss of material of carbon steel bolting on mechanical closures can lead to loss of mechanical closure integrity. Tables 3.4-3 and 3.4-9 of the ANO-1 LRA should indicate that the Maintenance Rule Program applies to the aging effect of loss of material.

(c) The LRA takes credit for the Maintenance Rule Program to manage the applicable aging effects for components in each of the systems listed above (it appears that system walk-downs are being used to managing aging internally and externally). Provide a discussion on how visual inspection performed during system walk-downs can effectively detect each of the applicable aging effects before loss of intended function.

The Maintenance Rule Program system walk-downs apply to external surfaces only. They are used to manage loss of material and loss of mechanical closure integrity, and they manage these aging effects by detecting degradation of the coatings on piping, bolting, and other components.

The Maintenance Rule Program is not credited for managing aging effects for internal surfaces. For the internal surfaces of components in Tables 3.4-3 and 3.4-5 of the ANO-1 LRA, other aging management programs are credited with managing loss of material. The Maintenance Rule Program only applies to management of the loss of mechanical closure integrity. Specifically, the Maintenance Rule

Program manages loss of mechanical closure integrity for carbon steel heat exchangers in the lube oil environment (page 3-64), air intake and exhaust subsystems carbon steel components in the gas-air environment (page 3-66), and heat exchanger cast iron components in the gas-air environment (page 3-67).

(d) **Discuss the frequencies of the activities performed or describe the method used to determine the frequency in sufficient detail for the staff to assess the adequacy of the process used.**

For each of the auxiliary systems that credit the Maintenance Rule Program, system engineers are expected to perform walk-downs at least once per refueling cycle. This frequency is acceptable since the aging effects are typically caused by long-term degradation mechanisms such as corrosion.

(e) **The operating experience and demonstration is too general and additional details are needed to provide the staff with reasonable assurance that the system walk-downs (that use visual inspection and engineering judgement to determine "unacceptable visual indications") will be effective in managing aging during the period of extended operation. For example, has ANO-1 experienced any failures for the aging mechanisms in the auxiliary systems since the implementation of the walk-down program. Discuss how long the system walk-downs have been in place at ANO-1, describe the qualifications and training system engineers receive, qualitatively describe the types and frequency of indications found as a result of the programs, and discuss some specific findings that will help the staff assess the effectiveness of the program.**

The Maintenance Rule Program is a relatively new program, and baseline walk-downs were initiated in 1997. Indications of aging identified during the baseline structural and component inspections included some areas with exposed rebar which was slightly rusted, minor water inleakage, and numerous concrete surface cracks, which did not exceed the acceptance criteria. The degradation was assessed and corrective actions were implemented. None of the findings resulted in a loss of a component's intended function, and no loss of intended function has occurred for a component from age related degradation not detected during the baseline inspection. The program will continue to focus on detection and repair prior to loss of component function. Program adjustments will be made based on information gained from on-going site-specific and industry experience.

Structural and component inspections are conducted under the Maintenance Rule Program by qualified engineers. Personnel are qualified in accordance with ANO's Engineering Support Personnel (ESP) Training Program that provides assurance of an appropriate level of knowledge and experience prior to performing engineering activities. The ESP Training Program is an INPO accredited program.

The engineer responsible for Maintenance Rule assessment of structures and components evaluates the identified findings. This person is also trained in accordance with the ESP Program. As such, this person is qualified to perform a preliminary assessment of degradation in accordance with 10CFR50.65. Additionally, checklists are provided to qualified personnel performing the structural and component walk-downs. Various indications of potential degradation are listed on the checklists. Deficiencies are documented on program specific report forms. The Maintenance Rule Program's walk-down guidelines have been approved in accordance with the site 10CFR50, Appendix B Program.

Finally, the Maintenance Rule Program is an NRC approved program that is part of ANO-1's current licensing basis. This program, as described in Section 4.13 of Appendix B of the ANO-1 LRA, is similar to the Inspection Program for Civil Engineering Structures and Components that was approved by the NRC Staff in NUREG-1723, Safety Evaluation Report Related to the License Renewal of Oconee Nuclear Station, Units 1, 2, and 3.

3.3.4.3.2-10 This request applies to managing loss of mechanical closure integrity in the following seven systems:

- **Spent Fuel**
- **Fire Protection**
- **Emergency Diesel Generator**
- **Auxiliary Building Sump and Reactor Building Drains**
- **AAC Diesel Generator**
- **Fuel Oil**
- **Chilled Water**

Several AMPs have been credited with managing the loss of mechanical closure integrity in these systems. Only in one of these program, Emergency Diesel Generator Testing and Inspections Program, identifies periodic checking of the bolt torque to further ensure the integrity of the bolted closures. Include a periodic check of bolt torque for those structures and components that have loss of

mechanical closure integrity as an applicable aging effect or provide a technical justification for not needing to periodically check bolt torque for each application.

The Boric Acid Corrosion Prevention Program, the ASME Section XI ISI-IWD (pressure testing) and the Reactor Building Leak Rate Testing Program manage loss of mechanical closure integrity in the spent fuel system as shown in Table 3.4-1. These programs are described in the ANO-1 LRA Appendix B, Section 4.5 on page B-43; Section 4.3.3 on page B-32; and Section 4.16 on page B-79.

As shown in Table 3.4-2, the Preventive Maintenance Program and the Fire Suppression Water Supply System Surveillance manage loss of mechanical closure integrity in the intake air subsystem, the exhaust air subsystem, and the lube oil subsystem of the fire protection system. The Preventive Maintenance Program should be shown as managing the loss of mechanical closure integrity for the cooling water subsystem. The Oil Analysis should not be shown as managing loss of mechanical closure integrity for the lube oil subsystem. Appendix B, Section 4.15, should indicate loss of mechanical closure integrity in the intake air subsystem, the exhaust air subsystem, the lube oil subsystem and the cooling water subsystem of the fire protection system is managed by the Preventive Maintenance Program. This is the conclusion of the aging management review.

Table 3.4-4 should indicate loss of mechanical closure integrity is managed by the Boric Acid Corrosion Prevention Program for carbon steel component commodity groupings. This program is described in Appendix B, Section 4.5 on page B-43. Loss of mechanical closure integrity should not be shown as an aging effect for the stainless steel piping and valves in Table 3.4-4. These changes are consistent with the aging management review.

Table 3.4-7 should indicate that loss of mechanical closure integrity is managed by the Emergency Diesel Generator Test and Inspection Program, the Alternate AC Diesel Generator Test and Inspection Program, and the fire protection diesel inspections which are part of the preventive maintenance activities. Due to an administrative error, the fire protection diesel inspection preventive maintenance activity was omitted from Table 3.4-7 and Appendix B, Section 4.15. The preventive maintenance activity description is provided below as part of the response to this question. The other programs are described in Appendix B, Section 4.21.5 on page B-99, and Section 4.2 on page B-25. These conclusions are consistent with the aging management review.

Preventive Maintenance Activity: Fire protection diesel inspection
Aging Effects Addressed: Loss of material, cracking, and loss of mechanical closure integrity
Activities: At least every 18 months, each diesel generator is given an inspection following the manufacturer's recommendations. The following are maintenance actions that support the management of aging effects.

- The turbo charger is leak tested.
- Air intake piping is inspected for loose clamps, cracks, punctures and tears.
- The throttle linkage is checked for servo leaks.
- The fuel manifold pressure is checked.
- The fuel injectors are removed, reinstalled and adjusted. The valves are also adjusted and the cross-head clearances are checked.
- The water pump is replaced.
- The turbocharger rotating assembly end-play is checked, as is the radial clearance on the compressor wheel.

These activities are performed in accordance with manufacturer's recommendations, NFPA Fire Codes, and the ANO-1 SAR, Section 9D.2. Routine maintenance in accordance with the manufacturer's recommendations has proven effective throughout the power industry for management of aging effects on diesel fire pump subsystem components. Based on a review of industry experience and ANO condition reports regarding the diesel fire pump, these inspections provide reasonable assurance that the aging effects will be managed such that the diesel fire pump will continue to perform its intended function consistent with the current licensing basis for the period of extended operation.

3.3.4.3.2.1-1 **The Primary Chemistry Monitoring Program description contains a statement that inspections are performed when the Spent Fuel System becomes available because of routine or corrective maintenance. These inspections include checking for corrosion, deposits, structural damage, clarity of water, general cleanliness, appearance, and biological growth. This program is also credit with managing cracking of stainless steel. To determine whether these inspections help to ensure that unanalyzed cracking does not occur, the staff**

needs to know whether these inspections check for cracking, the techniques used, the maximum allowable time between inspections, and how many times such inspections of Spent Fuel System stainless steel components have been performed to date.

The Primary Chemistry Monitoring Program is a preventive program and does not include performing inspections.

Section 4.6 of Appendix B, Chemistry Control, states that chemistry inspections are frequently performed on components and systems that are available due to routine or corrective maintenance. This statement is in the introduction to all of the chemistry programs and applies in general to all of these programs. These chemistry inspections are not performed on all systems and components at a specific frequency and these inspections are not credited with managing the effects of aging. The inspection results help to demonstrate the effectiveness of aging management programs in preventing aging effects.

The Primary Chemistry Monitoring Program manages cracking of the stainless steel components in the spent fuel system by preventing the aging effect from occurring. For the liner plate exposed to the borated water environment, Table 3.4-1 should have included a footnote reference after the aging effect to indicate that the aging effect is prevented by the referenced program or activity. This footnote was omitted through an administrative error.

Additionally, the Spent Fuel Pool Level Monitoring Program and the Spent Fuel Pool Monitoring Program adequately manage cracking of the external surfaces of the stainless steel spent fuel pool liner plate. For the external surfaces of the liner plate, Table 3.4-1 also should have listed the Spent Fuel Pool Monitoring Program as an applicable aging management program. The program description in Appendix B indicates its applicability to the liner plate, but due to an administrative error the program name was omitted from Table 3.4-1.

3.3.4.3.2.1-2 Appendix B, Section 4.21.8 of the LRA, contains a statement that together with the new program, Spent Fuel Pool Monitoring, described in Appendix B, Section 3.7, of the LRA, the Spent Fuel Pool Level Monitoring Program will provide reasonable assurance that cracking of the liner plate will be managed. However, in Section 3.4 of the LRA, only the Spent Fuel Pool Level Monitoring Program is credit with managing cracking in the liner plate. Verify that both the Spent Fuel Pool Level Monitoring and the Spent Fuel Pool Monitoring Programs are need to manage cracking of the liner plate

or provide a technical justification as to why only the Spent Fuel Pool Level Monitoring Program will adequately manage cracking during the period of extended operation.

Both the Spent Fuel Pool Level Monitoring Program and the Spent Fuel Pool Monitoring Program are credited to manage cracking of the external surfaces of the liner plate. Due to an administrative error, the Spent Fuel Pool Monitoring Program name was omitted from Table 3.4-1 of the ANO-1 LRA.

3.3.4.3.2.1-3 **The Spent Fuel Pool Level Monitoring Program and the Spent Fuel Pool Monitoring Program can detect cracking in the spent fuel liner plate only after it becomes through-wall. Because material loss and cracking (but not through-wall cracking) can occur and remain undetected, the staff believes that a one-time volumetric inspection be performed just prior to the period of extended operation of selected susceptible locations on the liner plate to ensure that significant cracking or loss of material has not occurred. Include a one time inspection as part of ANO-1 AMP for cracking of the spent fuel pool liner plate or provide a technical justification as to why it is not needed. If a one time inspection is added, identify the acceptance criteria and the proposed locations for the one-time inspection.**

A one-time inspection of the ANO-1 spent fuel pool liner plate is not needed prior to entering the period of extended operation for the following reasons. The spent fuel pool walls are lined with 3/16 inch, type 304L stainless steel. This liner provides little structural strength and is nonsafety-related. (Note: The acceptability of a nonsafety-related spent fuel pool liner is acknowledged in footnote 1 of the NRC Standard Review Plan 9.1.2, "Spent Fuel Storage," which identifies that for operating licenses issued before November 17, 1977 analysis of a non-Q liner was not required and is not considered necessary since stresses in the liner in the event of a safe shutdown earthquake will be low and therefore liner failure is unlikely.) The purposes of the spent fuel pool liner are to protect the concrete walls from direct contact with the borated water, form the leak barrier with respect to the telltale drains behind the liner, and maintain the leak tightness of the pool. Because the liner does not serve a structural function except as a fluid-retaining boundary, detecting and, if needed, measuring and trending leakage from the spent fuel pool is adequate for aging management. If any leakage is detected, the cause will be determined and appropriate corrective action will be taken prior to loss of the intended function.

The NRC Staff has previously found leakage detection acceptable for aging management for components that only provide a fluid-retaining function. Specifically, in Section 3.10.3.2.6 of NUREG-1705, "Safety Evaluation Report Related to the License Renewal of Calvert Cliffs Nuclear Power Plant, Units 1 and 2," the NRC Staff indicated that, for the refueling pool liner and the refueling pool permanent cavity sealing ring, detecting and, if needed, measuring and trending leakage was an acceptable aging management approach.

3.3.4.3.2.1-4 Define what constitutes an "unacceptable drop in the pool level" and provide the basis for this value.

The spent fuel pool has a level alarm that alarms in the control room at 0.5 feet below normal level. Due to evaporation, the spent fuel pool level slowly decreases over time. This is normal and the operators ensure the alarm does not come in by refilling the pool on a regular basis. If the alarm does come in, the operators are required by procedure to go to the spent fuel pool and visually verify level. So, an "unacceptable drop in the pool level" would be constituted by an unexplained low level alarm in the spent fuel pool (more than could be attributed to normal evaporation).

3.3.4.3.2.1-5 The following questions relate to ASME Section XI inspection activities relating to the Spent Fuel Pool.

(a) The system description contained a statement that the IWD visual inspections was performed during system pressure tests in accordance with NRC-approved versions of ASME Section XI. Provide a description of the inspection results in sufficient detail to allow the staff to evaluate the effectiveness of this program to manage loss of material in spent fuel system carbon steel bolting.

The component commodity groupings that credit visual inspections are bolting and external valve parts. The aging effects are loss of material and loss of mechanical closure integrity. Boric acid leakage would be identified before loss of intended function. The visual inspections are used, in addition to the inspections and tests required by the Boric Acid Corrosion Prevention Program and Reactor Building Leak Rate Testing, to manage the aging effects. Table 3.4-1 should have referenced IWC for the pressure tests since the piping is ASME Class 2.

(b) The LRA contains a statement that VT-3 visual examinations are performed in accordance with NRC-approved versions of ASME

Section X1. Provide a description of the inspection results in sufficient detail to allow the staff to evaluate the effectiveness of this program to prevent loss of mechanical closure integrity.

For the spent fuel pool system, loss of mechanical closure integrity is managed by a combination of the ASME Section XI Inspections, the Boric Acid Corrosion Prevention Program, and Reactor Building Leak Rate Testing. The potential for loss of mechanical closure integrity would be due to the loss of material resulting from leakage of boric acid on the external bolts and valve parts. Visual inspections performed during ASME Section XI pressure tests provide an opportunity to identify boric acid leakage that could lead to loss of mechanical closure integrity. As discussed in Appendix B, Section 4.5 of the ANO-1 LRA, visual inspections performed to identify boric acid leakage have been demonstrated effective in managing loss of material of bolting that could eventually lead to loss of mechanical closure integrity.

(c) The aging management program IWD Inspections, described in Section 4.3.3 of Appendix B to LRA, include the VT-3 examination to determine the general mechanical and structural condition of components. But the ASME Code Section XI, 1992 Edition, 1993 Addenda for Pressure Testing, ISI-IWD Program, does not include the VT-3 visual examinations for the system leakage test of the pressure retaining components, these examinations are included in the ASME Section XI ISI-IWB. Verify that Appendix B, Section 4.3.3, should be referring to IWB, not IWD, or provide an explanation for this discrepancy.

As stated in the response to part (a) of this RAI, the piping inspection is performed per IWC since the piping is ASME Class 2. VT-3 examinations in IWC or IWD apply to integral attachments such as snubbers and structural supports, not to pressure retaining components. During system leakage tests, VT-2 examinations are performed of the pressure retaining components. IWB inspections only apply to ASME Class 1 components and thus are not applicable to spent fuel system components.

3.3.4.3.2.1-7 **Appendix B, Section 4.5, "Boric Acid Corrosion Prevention" contains a statement that the program has been successful in "ensuring the proper identification, evaluation, and repair of boric acid leakage. Leakage is being reported not only on the reactor coolant system components, but also on other systems that contain borated water. This program has helped in the reduction of unidentified reactor**

coolant system leakage." Has the Boric Acid Corrosion Prevention Program fail to identify incidents of early leakage (i.e., RCS level taps). If so, describe these incidents and any improvements to the program to prevent future failures to identify early leakage.

Please described specific experience in applying the program to spent fuel pool carbon steel bolting and other carbon steel components at ANO-1, so the effectiveness of the program can be evaluated.

Entergy Operations established the Boric Acid Corrosion Prevention Program at ANO-1 to reduce leakage and corrosion of borated water systems. The program was developed in accordance with the recommendations delineated in NRC Generic Letter 88-05, Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants, and both the EPRI and NEI (formerly NUMARC) guidelines were used during the program development. Although Generic Letter 88-05 was primarily concerned with the reactor coolant system, the ANO-1 program exceeds the scope of the generic letter and applies to any leakage with the potential for boric acid to corrode plant components or piping.

A boric acid evaluation database stores information on the occurrence of boric acid leaks and allows trending for determination of repeat occurrences. Over 60 leaks have been identified and evaluated since the program was implemented. These leaks have been reported on both reactor coolant system components and on other systems that contain borated water. In response to these leaks, engineering evaluations were performed. As a result of these evaluations, component repairs and replacements have been performed. This experience provides reasonable assurance that continued implementation of the Boric Acid Corrosion Prevention Program will effectively manage the aging effects associated with boric acid leakage 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. This program is similar to the Boric Acid Wastage Surveillance Program approved by the NRC in NUREG-1723, Safety Evaluation Report Related to the License Renewal of Oconee Nuclear Station, Units 1, 2, and 3.

3.3.4.3.2.2-1 **Appendix B, Section 4.8.4, of the LRA contains a statement that aging management program and activities provide a method for verifying operability of Fire Suppression Sprinkler System components. Although sprinkler heads are included among the fire protection components subject to an AMR in Section 2.3.3.2, Table 3.4-2, of the LRA, no reference is made to the sprinkler heads or to the Fire**

Sprinkler System Surveillance Program. Explain why this program is not addressed in Table 3.4-2.

Section 2.3.3.2, also contains a statement that the Fire Suppression Sprinkler System is within the scope of license renewal and subject to an AMR. Appendix B, Section 4.8.4, to the LRA states that the fire suppression system surveillance provides a method for verifying the operability of the Fire Suppression Sprinkler System components and that the deluge spray system is flushed quarterly. However, the acceptability of automatic wet-pipe sprinkler systems in some portions of the turbine building containing lube oil piping, and in some areas of the auxiliary building including the cable spreading room was not discussed. Discuss how operability of the deluge spray system is determined in these areas.

Due to an administrative error, Fire Suppression Sprinkler System Surveillance was omitted from the fire protection system Table 3.4-2 of the ANO-1 LRA. This activity is credited for managing aging of the sprinkler heads. The sprinkler heads are made of the same material and subject to the same environment as the fire protection system piping, and are therefore included in the commodity grouping "piping" listed in Table 3.4-2.

Automatic wet-pipe sprinkler systems in portions of the turbine building containing lube oil piping are not within the scope of license renewal. The deluge system protecting the cable spreading room is in the scope of license renewal. Operability of this system is determined in accordance with the current licensing basis as described in the ANO-1 SAR Section 9D.3.4.

3.3.4.3.2.2-2 Appendix B, Section 4.8.3, "Fire Suppression Water Supply System Surveillance," to the LRA, describes periodic surveillance tests of Fire Protection System components. Section 4.8.3 contains a statement that the deluge spray system is flushed quarterly. However, the acceptability of the automatic wet-pipe sprinkler systems located in some portions of the turbine building containing lube oil piping, and in some areas of the auxiliary building including the cable spreading room, was not discussed. For these areas discuss the criteria used for determining that the Deluge Spray System is operable; and discuss the surveillance procedure and criteria used to verify that a wet pipe sprinkler system required for compliance with 10CFR50.48, remains operable throughout the extended period of operation. These include pressurization and flow testing of portions of the system.

(a) Fire suppression Water Supply System Surveillance is not credited with managing the "loss of mechanical closure integrity" in Appendix B, Section 4.8.3, of the LRA. However, Table 3.4-2 does credit this program for managing the loss of mechanical closure integrity for several components. Verify that the Fire Suppression Water Supply System Surveillance Program is used to manage the loss of mechanical closure integrity or provide a technical justification as to why it is not needed to manage this aging effect.

The Fire Suppression Water Supply System Surveillance is used to manage the loss of mechanical closure integrity for fire protection system components as indicated in Table 3.4-2 of the ANO-1 LRA. Loss of mechanical closure integrity should have been included among the aging effects listed in the ANO-1 LRA, Appendix B, Section 4.8.3

(b) Describe the scope (i.e., physical boundaries of each of these pressurization and flow tests, for each of the surveillance activities), the operating parameters measured during and/or after each of the periodic surveillance tests listed, the acceptance criteria and its bases, and the method(s) for analyzing results of the surveillance tests.

The Fire Suppression Water Supply System Surveillance is primarily credited with managing aging effects for components in the diesel fire pump subsystems. These components are observed during testing of the diesel fire pump allowing for identification and correction of degradation due to aging.

The Fire Suppression Water Supply System Surveillance was also credited as one program for aging management of system piping. The operating parameter responsible for managing this aging is system pressure. If the pipe had degradation due to an aging effect, it would be detected when the system pressure could not be maintained. During the performance of each of the listed surveillance activities, a pump is running, pressurizing the water filled portions of the system piping. Since the fire suppression water supply system is non-seismic, leakage detection, in conjunction with the Fire Water Piping Thickness Evaluation Program and preventive activities under the Service Water Chemical Control Program, is acceptable for managing the applicable aging effects on the system piping.

Though not formally credited as part of the aging management activities, the ability to readily detect significant system leakage also addresses aging effects for the fire protection system piping. Between surveillance tests, the jockey fire pump normally maintains the system pressurized. If leakage from system piping exceeds the capacity of the jockey fire pump, then decreasing system pressure will start the electric motor driven main fire pump. The automatic starting of the fire pump will be indicated in the control room and actions will be taken to determine and correct the cause. In addition, plant walk-downs routinely completed by Operations and System Engineering personnel would likely detect leakage long before approaching the capacity of the jockey fire pump.

(c) Describe how the loss of material and fouling of the Fire Protection Heat Exchanger is detected by the Fire Suppression Water Supply Surveillance. Is the Fire Protection Heat Exchanger in the ANO-1 Generic Letter 89-13 Program?

Fire protection heat exchangers are subcomponents of the fire pump diesel engine. These heat exchangers are a jacket water heat exchanger, a gearbox oil cooler, and an engine lube oil cooler. During surveillance testing of the diesel driven fire pump, a high temperature alarm for the cooling water would indicate excessive fouling of the heat exchangers. As discussed in the RAI response 3.3.4.3.2-10, due to an administrative error, the fire protection diesel inspection preventive maintenance activity was omitted from Table 3.4-7 and Appendix B, Section 4.15 of the ANO-1 LRA. The inspections manage the effects of loss of material and fouling such that the fire protection system can perform its intended function under current licensing basis design conditions during the period of extended operation. The fire pump heat exchangers are not in the ANO-1 Generic Letter 89-13 Program.

(d) Section 4.8.3 of Appendix B, to the LRA, under Operating Experience and Demonstration contains the following statement:

> **Inspections of the underground cement-lined cast iron piping have shown negligible corrosion degradation. The above ground carbon steel pipe is inspected during repair or replacement of firewater components. There have been replacements of components and piping in the small-bore carbon steel piping due to internal corrosion. Based on this experience, these [as described in the Fire Suppression Water Supply System Surveillance Program] surveillance activities will continue to provide assurance that aging effects will be adequately managed.**

Addition information is needed relating to the operating experience of the Fire Suppression Water Supply System Surveillance Program to demonstrate the effectiveness of the AMP to manage the aging effects during the period of extended operation. Provide more information about the timing and extent of the inspection of the underground piping that provides reasonable assurance that the program is currently and will continue to adequately manage the effects of aging during the period of extended operation. Discuss the reason for the inspection, were repairs needed, did the surveillance program identify the need for repairs. Are inspections performed periodically, and if so, should these inspection activities of the underground piping be part of the aging management activities, if not, justify why not. Because inspection activities are relied upon to demonstrate the effectiveness of this program, then the staff believes that inspection(s) should be part of the AMP, if not, justify why not.

The inspections performed during repair and replacement of fire-water components are described in the program description of the Fire Suppression Water Supply System Surveillance. Correlate the repairs and replacements to the surveillance program activities. Has the Fire Suppression Water Supply System Surveillance identified the need for repairs and replacement activities, if not, then what activities were used to identified the need for repairs and replacements and why are they not part of the AMP. What can be said about the operating experience relating specifically to Fire Suppression Water Supply System Surveillance Program that demonstrates its effectiveness to manage the aging during the period of extended operation.

Inspection activities are not credited for managing aging effects on the fire system piping. Inspection results from maintenance activities were cited in the program description as evidence that corrosion degradation of the underground piping has been negligible and that the continuation of the surveillance activities will manage the identified aging effects.

The Fire Suppression Water Supply System Surveillance did not identify the need for the repairs and replacements of service water piping discussed in the operating experience. The cited repairs and replacements were addressed under the corrective action program and the information was evaluated to determine the need for changes to aging management programs such as surveillance and inspection activities. Though not formally credited as part of the Fire Suppression Water Supply Surveillance aging management activities, Entergy Operations has the ability to readily detect significant system leakage during routine operation to address aging effects for fire protection system piping. Between surveillance tests, the jockey fire pump normally maintains the system pressurized. If leakage from system piping exceeds the capacity of the jockey fire pump, then decreasing system pressure will start the electric motor driven main fire pump. The automatic starting of the fire pump will be indicated in the control room and actions will be taken to determine and correct the cause. In addition, plant walk-downs routinely completed by operations and system engineering personnel would likely detect leakage long before approaching the capacity of the jockey fire pump.

Anytime a repair or replacement activity is required to address an aging effect that could impact the intended function of the fire protection system, the need for changes in surveillance and inspection activities is assessed. The results of such assessments done under the corrective action program are factored into any needed changes to these programs, including the Fire Suppression Water Supply System

Surveillance. This formal process of continuous feedback ensures that the aging management activities are providing the needed level of protection from potential system loss of intended function.

3.3.4.3.2.2-3 Appendix B, Section 4.8.5, "Fire Water Piping Thickness Evaluation," to the LRA, describes periodic examination and evaluation of pipe wall thickness changes in the Fire Water System. Please provide the following additional information:

(a) Table 3.4-2 of the LRA identifies the Fire Water Piping Thickness Evaluation for managing loss of material in cast iron and carbon steel materials. However, in Appendix B, Section 4.8.5, "Fire Water Piping Thickness Evaluation," of the LRA contains a statement that the program also applies to piping made of stainless steel. Verify that the Fire Water Piping Thickness Evaluation is used to manage the loss of material for stainless steel or provide a technical justification for not using this AMP to manage the loss of material in stainless steel.

Appendix B, Section 4.8.5 of the ANO-1 LRA should be consistent with Table 3.4-2, in not crediting the Fire Water Piping Thickness Evaluation for managing loss of material for stainless steel piping and valves. The Service Water Chemical Control Program as shown in Table 3.4-2 prevents loss of material for the stainless steel piping and valves. As shown in Table 3.4-2, the Fire Suppression Water Supply System Surveillance manages cracking of the stainless steel piping. Though not specifically credited in Table 3.4-2, the ability to detect leakage with the system in normal standby conditions is an effective aging management activity for loss of material and cracking. Since the fire water system is non-seismic, leakage detection will trigger action to isolate the affected portion of the system and effect repairs without loss of system function. The Fire Water Piping Thickness Evaluation merely provides the opportunity to identify degradation before leakage occurs which will allow for planned corrective actions rather than unplanned response to leakage as it occurs.

(b) Appendix B, Section 4.8.5, "Fire Water Piping Thickness Evaluation," of the LRA does not describe the ultrasonic scanning coverage methods used for Fire Protection System piping. Provide addition description of the method used, include in this description the use longitudinal wave ultrasonic, the use of grid point measurements, and specifics relating to scan coverage with respect to the overall size, population, and shape of the pitting degradation (describe the ultrasonic coverage methods for

ensuring that a loss of material due to pitting will be appropriately detected and characterized).

The ultrasonic thickness examinations in the Fire Water Piping Thickness Evaluation are performed in accordance with site procedures for NDE. This ensures the examinations are performed using industry accepted ASNT and EPRI methods, by qualified personnel, using calibrated equipment. It also ensures results of examinations are properly recorded. The Fire Water Piping Thickness Evaluation provides instructions regarding selection of inspection locations by the system engineer, determination of wall thickness, and acceptance criteria. Should the acceptance criteria not be met the results of the examinations are provided to design engineering for further evaluation. The corrective action program is utilized if requirements for minimum wall thickness are not met.

(c) Appendix B, Section 4.8.5, "Fire Water Piping Thickness Evaluation," of the LRA contains a statement that the frequency and locations of ultrasonic examinations are determined by the system engineer, based previous and nearby inspections and elapsed time. Describe the method used to determine the time between examinations including the objective, basis and method used to determine the elapse time. Describe the bases and extent of sampling (locations examined) and expansion criteria, with respect to the total population of applicable components. Discuss the acceptance criteria, the basis for what is and what is not an acceptable loss of material. Describe the method(s) for analyzing results of the ultrasonic examinations.

Fire water piping is examined at a frequency determined by the system engineer. The system engineer uses his knowledge of the system to determine the frequency of inspection. Since the purpose of the examinations is to monitor and trend pipe wall thickness, the frequency of inspection varies from place to place within the scope of the examinations. There is no set frequency for the inspections. They are performed considering the parameters above with the objective of detecting degradation prior to loss of system function. The selection process for inspection locations considers areas of concern based upon previous inspections, the time since previous inspections, inspections of nearby or representative piping, the need for additional inspections to characterize the condition of a pipe section, the consequences of failure, and locations concerning safety related or other critical equipment. This is acceptable since leakage detection will allow for isolation and repair of affected portions of the system without loss of function.

The acceptance criterion is based on the applicable pipe code (e.g., ASME B31.1) minimum pipe wall thickness requirements. Examination results that fail to meet this criterion are provided to design engineering for analysis. A condition report is written for any pipe wall location that does not meet its applicable code required wall thickness. Corrective actions are accomplished under the site corrective action program.

(d) Ultrasonic thickness examinations have indicated that pitting corrosion of Fire Protection System piping is an ongoing degradation mechanism at ANO-1, and that piping repairs have been made because of excessive pipe wall thinning. Please discuss how many (qualitatively) of the repairs have been initiated because of the Fire Water Piping Thickness Evaluation Program in contrast to failure detection, actual leakage due to failure of the piping.

Several inspections have been performed under the Fire Water Piping Thickness Evaluation Program since its implementation in 1998. No components have been replaced or repaired based on results from the Fire Water Piping Thickness Evaluation Program. However, in 1998 and 1999, three instances of fire protection system pipe leaks due to wall thinning were evaluated and repaired. The operating experience from these cases has been used to improve the detection and mitigation elements of this program. Although this program has not identified the need for any repairs or replacements, it is similar to the service water system pipe wall thickness monitoring activity. The service water pipe wall thickness monitoring has identified degradation in local areas of the system. Based on such findings, piping replacements have been performed prior to loss of system function.

3.3.4.3.2.2-4 Appendix B, Section 4.6.5, "Service Water Chemical Control," to the LRA, describes sampling and analysis activities of the service water system. Please provide the following additional information:

(a) Appendix B, Section 4.6.5, Service Water Chemical Control of the LRA, contains a statement that biocides are continuously injected to control biological activity in this raw water system. State whether these biocides, based on the chemical species present, contribute to corrosion or cracking.

The service water chemical treatment using biocides can contribute to corrosion, however improved use of corrosion inhibitors minimizes this corrosion. Monitoring is performed to evaluate the effectiveness of the treatment and to make adjustments as needed to effectively manage fouling and corrosion. The injection of corrosion inhibitors has significantly reduced piping corrosion rates in the system.

The combination of biocides and corrosion inhibitors to the service water system have been effective in managing biological fouling and in reducing corrosion. For additional discussion on the chemical treatment of the service water at ANO-1, please see the Entergy Operations to NRC letter dated February 17, 2000 (0CAN020001).

(b) **The "Operating Experience and Demonstration" does not discuss the history of the fire protection system piping with respect to the aging effects managed by the Service Water Chemistry Control Program. A general description of the operating history of the system is needed. In addition, discussion as to whether or not the need for repairs and replacements have been detected primarily by the applicable AMPs. If not, what initiated these maintenance activities? Have there been failures not detected by the AMP, and if so, have the credited AMPs been adjusted to prevent future undetected failures?**

The fire protection system should have been included in the Service Water Chemistry Control Program "Operating Experience and Demonstration" discussion in Appendix B on page B-52. In 1998, Entergy Operations initiated the Fire Water Piping Thickness Evaluation program that will detect general corrosion of the fire protection system above ground piping (see Appendix B, Section 4.8.5). The fire protection system piping has experienced three leaks in recent years. These leaks were due to general corrosion of the fire protection system above ground carbon steel piping. The three leaks were evaluated in accordance with the corrective action program and the results have been incorporated into the surveillance activities associated with the Fire Water Piping Thickness Evaluation Program.

3.3.4.3.2.3-1 **Table 3.4-3, "Emergency Diesel Generator System," of the LRA indicates that fouling is an aging effect that potentially affects the pressure boundary of the lube oil subsystem heat exchangers. However, Appendix C, Sections 4.3.3 and 10.2.2 of the LRA states that fouling is not associated with loss of pressure boundary. In addition, during a telecommunication on June 6, 2000, you stated that fouling is not an aging mechanism that can lead to the loss of pressure boundary. Verify that Table 3.4-3, page 3-63 is incorrect, or provide**

a discussion relative to fouling and the loss of pressure boundary specific to this application.

Fouling is not an aging effect that can lead to a loss of pressure boundary. For Table 3.4-3 of the ANO-1 LRA, inclusion of fouling as an aging effect for the pressure boundary function of the lube oil subsystem heat exchangers was an administrative error.

3.3.4.3.2.3-2 **Appendix B, Section 4.21.5 of the LRA, contains a statement that the Emergency Diesel Generator Testing and Inspections Program provides a means of detecting cracking and loss of material in these subsystems that have progressed to the point of leakage. The staff's concern is that significant loss of material or cracking may remain undetected beyond the loss of intended function, and the existing program is relying on failure detection to manage aging. Demonstrate that the effects of aging will be manage consistent with the CLB during the period of extended operation without the loss of intended function, or provide additional aging management activities, as necessary, to prevent the loss of the intended function(s).**

Section 4.21.5 of Appendix B of the ANO-1 LRA states, "A check is made for exhaust leaks, cooling water leaks, or lube oil leaks, while the engine is running. This would detect loss of bolted closure integrity, cracking or loss of material in these subsystems that had progressed to the point of allowing leakage." These statements are in a bulleted list of examples of the maintenance actions that support the management of aging effects. These leak detection actions are not the only maintenance activities relied upon in the Emergency Diesel Generator Testing and Inspections Program. Please see the remainder of the discussion of the Emergency Diesel Generator Testing and Inspections Program on page B-99 and B-100. Once every 18 months, each EDG is inspected in accordance with the manufacturer's recommendations. Such inspections have proven adequate throughout the power industry in assuring management of aging effects on diesel engines. Also, note that in Table 3.4-3 other programs or activities are credited with managing the effects of aging for the EDG system. These include Auxiliary Systems Water Chemistry Monitoring, Oil Analysis and Maintenance Rule.

3.3.4.3.2.3-3 Appendix B, Section 4.21.5 of the LRA, identifies six maintenance actions used to manage aging effects. Identify the frequencies of these actions, which are performed monthly and which are performed during the 18-month inspection.

ANO-1 Technical Specification 4.6.1 requires the Diesel Generator Testing and Inspections be performed at least once every 18 months. Please note that the six maintenance actions listed in Appendix B, Section 4.21.5 are examples of the activities performed during the Diesel Generator Testing and Inspections.

3.3.4.3.2.4-1 Table 3.4-4 of the LRA summarizes the Auxiliary Building Sump and React Building Drain System AMR. Please provide the following additional information:

(a) Table 3.4-4 of the LRA shows that internal surfaces of carbon steel piping, valves, bolting, and external valve parts are exposed to treated water and borated water. However, Appendix C, Section 2.0 of the LRA states that carbon steel components exposed to borated water are lined with stainless steel or Plastite® to protect them from direct contact with borated water. Please identify the lining material used in carbon steel components of the auxiliary building sump and reactor building drain system. If lining material is not used, provide a specific basis for why the applicable aging management programs in Table 3.4-4 of the LRA (for carbon steel components internally exposed to borated water) are sufficient to manage loss of material and a loss of mechanical closure integrity.

The only carbon steel components in the auxiliary building sump and reactor building drain system internally exposed to borated water are those associated with RCP lube oil collection. These components are included in the second row of Table 3.4-4 of the ANO-1 LRA. These components are not lined because the system is designed to collect oil leakage. However, leaks from the primary systems can cause borated water to enter the system, and thus borated water is listed in Table 3.4-4 as a potential environment for the internals of the reactor coolant pump oil leakage collection system. The RCP Oil Leakage Collection System Inspection manages the loss of material aging effect that could result if borated water comes in contact with carbon steel. Note that, as discussed in the RAI response 3.3.4.3.1.4-1(a), the first row of Table 3.4-4 is in error and should have only included carbon steel bolting.

(b) Stainless steel, brass, bronze, and admiralty components exposed internally to a treated or borated water environment may be susceptible to loss of material from general corrosion or pitting under certain conditions such as elevated oxygen, halogen or sulfate levels exacerbated by stagnant or low-flow conditions. Discuss how the AMPs which apply to the components made from these materials adequately manage this aging effect.

In Table 3.4-4 the aging management activity for the brass, bronze and admiralty valves should be preventive maintenance. This is consistent with the discussion of preventive maintenance in Section 4.1.5 of Appendix B of the ANO-1 LRA (page B-76).

Stainless steel components exposed internally to a treated or borated water environment are susceptible to loss of material and cracking. The aging management programs credited with managing this aging effect are indicated in Table 3.4-4 of the ANO-1 LRA. The aging management programs: ASME Section XI – Augmented Inspections; Reactor Building Leak Rate Testing; and Reactor Building Sump Closeout Inspection are discussed respectively in the ANO-1 LRA in Section 4.3.7 of Appendix B on page B-38; Section 4.16 of Appendix B on page B-79; and Section 4.17 of Appendix B on page B-82.

The ASME Section XI – Augmented Inspections will use the techniques of ASME Section XI to detect loss of material and cracking. The frequency of the inspections will be specified in the inservice inspection plan. Flaws will be evaluated against the acceptance standards in the code. Where required, corrective actions will be taken in accordance with the site corrective action program.

The parameter monitored in the Integrated Leak Rate Test is reactor building leak rate. Degradation of a component could result in leakage in excess of that permitted. The parameter monitored in the Local Leak Rate Test is containment isolation valve leakage rate. Degradation of a component could result in leakage in excess of that permitted. Leakage in excess of that permitted would be evaluated and resolved under the ANO Corrective Action Program.

This leak rate testing exposes the penetrations to the maximum pressure expected under accident conditions and then checks for leakage to verify the penetration integrity. This testing would help to identify system leakage and is credited as one of the methods of managing the aging effect of loss of material from boric acid corrosion. This testing would not detect cracking or loss of material that had not yet resulted in pressure boundary leakage. Therefore, the Reactor

Building Leak Rate Testing Program is used in conjunction with other programs to manage the aging effects of those particular components.

The Reactor Building Sump Closeout Inspection requires a visual inspection to manage loss of material and cracking. The inspection verifies the screens show no evidence of physical damage that could allow foreign objects greater than 1/8 inch to enter the sump. The inspection also looks for structural distress, corrosion, signs of rust, physical degradation, or tears in the screen. Acceptance criteria for the screens are described in the RAI response 3.3.4.3.2.4-6(b). This program is similar to the Containment Emergency Sump Inspection Procedures credited for Calvert Cliffs containment sumps and approved by the NRC in NUREG-1705, Safety Evaluation Report Related to the License Renewal of Calvert Cliffs Nuclear Power Plant, Units 1 and 2.

(c) Carbon steel components in the Auxiliary Building Sump and Reactor Building Drain System that are exposed internally to raw water may be susceptible to loss of material from general corrosion or pitting under certain conditions such as elevated oxygen, halogen or sulfate levels exacerbated by stagnant or low-flow conditions. Discuss how the AMPs, which apply to the components made from these materials, adequately manage this aging effect.

No carbon steel components in the auxiliary building sump and reactor building drain system subject to an aging management review are exposed internally to a raw water environment. Please see Table 3.4-4 of the ANO-1 LRA, which indicates that components exposed internally to raw water are stainless steel, brass, bronze or admiralty.

3.3.4.3.2.4-3 **Appendix B, Section 4.5, "Boric Acid Corrosion Prevention," to the LRA, describes corrosion prevention due to leakage relating to the Auxiliary Building Sump and Reactor Building Drain System. Please provide the following additional information:**

(a) Please verify whether any of the components of the Auxiliary Building Sump and Reactor Building Drain System are actually buried or encased in concrete so that their external surfaces are exposed to environments not listed in Table 3.4-4 of the LRA.

Some of the floor drains in the auxiliary building sump and reactor building drain system are embedded in concrete. However, although the floor drains that are credited for draining water are considered in the scope of license renewal, they do not require an aging management review because they are embedded in concrete and the integrity of the floor drain piping and component walls is not required for their intended function to be met. As shown in Table 3.6-4 (page 3-118) of the ANO-1 LRA, the aging management review of the concrete did not identify any aging effects.

The results of the aging management review of the reactor building penetrations associated with this system are provided in Section 3.6.1 and Table 3.6-2 of the ANO-1 LRA. The results of the aging management review of the structural steel for the sump, the sump divider plate and bolting are provided in Section 3.6.1 and Table 3.6-3 of the ANO-1 LRA.

(b) Describe specific operating experience relating to boric acid corrosion in the auxiliary building sump and reactor building drain system. Include a discussion on any enhancements to the program that may apply to the auxiliary building sump and reactor building drain system, and provide any information that shows this program will adequately manage aging in the auxiliary building sump and reactor building drain system.

Operating experience for the reactor building sump is described in Section 4.17 of Appendix B of the ANO-1 LRA under the heading "Operating Experience and Demonstration." No significant age-related degradation was identified during the review of operating experience.

3.3.4.3.2.4-4 **Appendix B, Section 4.8.7, "Reactor Coolant Pump Oil Collection System Inspection," of the LRA, describes inspection activities used to maintain the integrity of the Reactor Coolant Pump Oil Collection System as it relates to the Auxiliary Building Sump and Reactor Building Drain System. Please provide the following additional information:**

(a) In Appendix B, Section 4.8.7, to the LRA, you stated that the Reactor Coolant Pump Oil Collection System Inspection is visual. The scope of the inspection includes accessible piping of the Auxiliary Building Sump and Reactor Building Drain System. Please describe the extent of inaccessible piping and how the inaccessible piping of the Auxiliary Building Sump and Reactor Building Drain System that is exposed to an oil environment or an environment of borated water from component/system leakage will be inspected or evaluated.

The scope of the Reactor Coolant Pump Oil Collection System Inspection includes the shrouds, drip pans, accessible piping, collection tanks, and spray protection in the reactor coolant pump oil collection system. Portions of the piping penetrate a concrete floor as shown schematically on drawing LRA-M-238, sheet 1, at zones 6A and 7A. Degradation of the piping on either side of the concrete would be an indication that degradation of the piping penetrating the concrete may be occurring. The reactor coolant pump oil collection system is not seismically designed. Therefore, as long as it can drain the oil it is performing its intended function under its current licensing basis design loading condition.

(b) Please discuss the parameters monitored during the Reactor Coolant Pump Oil Collection System Inspection to determine the presence of corrosion and to characterize the nature of any degradation.

The Reactor Coolant Pump Oil Collection System Inspection specifically requires a condition report be prepared if the following conditions are noted: "abnormal accumulation of oil," "integrity of the collection system is found to be deficient" or "if oil is found that is not being collected." Condition report evaluation and resolution is controlled by the site corrective action program. Please note that while Entergy Operations conservatively determined loss of material is an aging effect requiring management for the reactor coolant pump oil collection system, it is expected that corrosion in this carbon steel lube oil collection system will be minimal. The operating history review performed during the aging management review did not identify any corrosion issues with the system.

(c) Please describe how the activities in the Reactor Coolant Pump Oil Collection System Inspection Program would detect aging effects before there is a loss of intended function for the applicable Auxiliary Building Sump and Reactor Building Drain System components in Table 3.4-4 of the LRA.

The Reactor Coolant Pump Oil Collection System Inspection Program provides for visual inspection of the reactor coolant pump oil collection system. In accordance with the ANO-1 current licensing basis, this is a non-seismic system. Therefore a visual inspection which verifies the oil is draining and the system is sound is adequate for managing aging effects during the period of extended operation. The operating history review performed during the aging management review did not identify any corrosion issues with the system.

3.3.4.3.2.4-5 Appendix B, Section 4.3.7, "Augmented Inspection" of the ASME Section XI Inservice Inspection, describes inspection activities used to maintain the Auxiliary Building Sump and Reactor Building Drain System. Please provide the following additional information.

(a) Table 3.4-4 of the LRA shows that the ASME Section XI ISI-Augmented Inspections Program is used to manage loss of material, cracking, and loss of mechanical closure integrity for stainless steel, brass, bronze and admiralty piping and valves in the Auxiliary Building Sump and Reactor Building Drains System. Verify that the Augmented Inspections Program is used to manage the loss of mechanical closure integrity because the program description in Appendix B, Section 4.3.7, only identifies loss of material and cracking.

The program described in Appendix B, Section 4.3.7 of the LRA lists lines from the reactor building sump, penetration 68 piping and components, the decay heat pump room drain valves, and penetrations 10, 47, 58 and 64. Confirm that all piping and valves of the listed materials in the Auxiliary Building Sump and Reactor Building Drains System are encompassed by the items listed above. State to which buildings the penetrations apply.

The Augmented Inspections Program is not used to manage loss of mechanical closure integrity. Local Leak Rate Testing, Reactor Building Leak Rate Testing and the Boric Acid Corrosion Prevention

Program are used to manage the loss of mechanical closure integrity for the carbon steel fasteners of the stainless steel and carbon steel reactor building isolation valves shown in Table 3.4-4 of the ANO-1 LRA.

In the auxiliary building sump and reactor building drains system, the stainless steel piping and valves associated with penetration 68, the Augmented Inspections Program manages loss of material and cracking. The Augmented Inspections Program manages loss of material and cracking for the stainless steel decay heat pump room drain valves. In Table 3.4-4 the activity for the brass, bronze and admiralty valves should be preventive maintenance. This is consistent with the discussion of preventive maintenance in Appendix B, Section 4.1.5 (page B-76). No other components in the auxiliary building sump and reactor building drains system credit the Augmented Inspections Program.

The lines from the reactor building sump penetrate the reactor building. Penetrations 68, 10, 47, 58, and 64 are reactor building penetrations. The decay heat pump room drain lines penetrate the floor of the decay heat pump room.

(b) Appendix B, Section 4.3.7, of the LRA, contains a statement that the methods used for augmented inspections are described in previous ASME Section XI sections. This is not clear, a specific description of the methods used for augmented inspections is needed, or more specific references that will allow the staff to assess the methods used. For example, it is unclear which of the NDE methods specified for ASME Class 1, 2 or 3 components will be applied to piping and valves in the Auxiliary Building Sump and Reactor Building Drains System. Please describe the specific examinations that will be performed and discuss why these examinations are effective at detecting the appropriate aging effects.

The welds of the piping wetted by the reactor building sump water will be subjected to volumetric examination. Specific welds in stainless piping of the main steam system will be subjected to volumetric examination. At least a one-time inspection of the penetration 68 piping and components will be accomplished. The method will be volumetric examination. At least a one-time inspection of the decay heat pump room drain valves will be performed using a volumetric method. Inspections of penetrations 10, 47, 58, and 64 will be performed using a volumetric method. These methods have proven effective in the industry for identifying cracking and loss of material.

(c) **Discuss operating experience specific to the applicable valves and piping in the Auxiliary Building Sump and Reactor Building Drains System. Provide a general assessment of the effectiveness of the program as it relates to the operability and availability of Auxiliary Building Sump and Reactor Building Drain System. Describe any detection of crack or loss of material that resulted in corrective actions and any failures caused by cracking or loss of material that were not detected by the Augmented Inspection Program. Discuss any changes to the program brought about by operating experience.**

In the search of ANO-1 operating experience, no age-related failures were found for the applicable valves and piping in the auxiliary building sump and reactor building drains system. The augmented inspection for this system is a new program and has not yet been performed. Thus, no assessment of the effectiveness of the program can yet be made based on program experience. In general, augmented inspections use the same non-destructive examination methods that are used for Section XI inspections on Class 1, 2, and 3 structures and components. These methods have proven effective in the industry for identifying cracking and loss of material.

3.3.4.3.2.4-6 **Appendix B, Section 4.17, "Reactor Building Sump Closeout Inspection," describes inspection activities used to maintain the Auxiliary Building Sump and Reactor Building Drain System. Please provide the following additional information**

(a) **Appendix B, Section 4.17, of the LRA, contains a statement that the Reactor Building Sump Closeout Inspection Program manage loss of material for the carbon steel components and cracking for stainless steel components due to borated water. This section also contains a statement that the scope of the Reactor Building Sump Closeout Inspection Program applies to the reactor building sump, the area surrounding the sump, the screening materials, and the equipment and structural components inside the sump. Table 3.4-4 of the LRA limits the components in this program to stainless steel screens in the Auxiliary Building and Reactor Building Drain System that are exposed to borated water, treated water, raw water, and oil. It is not clear that carbon steel components or any components other than the stainless steel screens are included in the Reactor Building Sump Closeout Inspection. Please clarify the scope of the program and the components included. Identify where in the LRA is the aging management review for cracking**

and loss of material for the carbon steel and stainless steel components.

The scope of the Reactor Building Sump Closeout Inspection Program described in Section 4.17 of Appendix B of the ANO-1 LRA is correct. The program applies to the reactor building sump, the area immediately surrounding the sump, the screening materials, and the equipment and structural components inside the sump. The results of the aging management review for the equipment and components inside the sump are provided in Table 3.3-2 under the "piping, valves, and appurtenances (wetted by sump water)" component commodity grouping. This grouping includes both carbon steel and stainless steel components. As noted in the RAI, the results of the aging management review of the sump screening materials are provided in Table 3.4-4 under the "screens" component commodity grouping. Finally, the results of the aging management review for the reactor building sump and the area immediately surrounding the sump are provided in Table 3.6-3. Note that the reactor building sump is part of the basement floor slab and the RAI response 2.4-2 (in correspondence dated August 30, 2000 (1CAN080007)) identified that Table 3.6-3 contained an administrative error where the term "basement floor slab" had been inadvertently deleted from the component commodity grouping column and the material for this slab, reinforced concrete, had been inadvertently identified in the component commodity grouping column.

(b) **Table 3.4-4 of the LRA contains a statement that the loss of material and cracking of the stainless steel screens are monitored under the reactor building sump closeout inspection. Appendix B, Section 4.17, contains a statement that visual inspection will be used to detect corrosion of carbon steel components and cracking in stainless steel components. It is unclear whether visual examination will be adequate to detect these aging effects before the function of the screens is compromised. If volumetric inspection techniques are excluded, explain how visual inspections will detect cracking before loss of intended function.**

Most of the stainless steel screen surfaces on the sump and the floor drains are dry during normal plant operation. The visual inspection of the screens is adequate to manage loss of material and cracking. The inspection verifies the screens show no evidence of physical damage that could allow foreign objects to enter the sump. The inspection also looks for structural distress, corrosion, signs of rust, physical degradation, or tears in the screen. This program is similar to the Containment Emergency Sump Inspection Procedures credited for Calvert Cliffs containment sumps and approved by the NRC in

NUREG-1705, Safety Evaluation Report Related to the License Renewal of Calvert Cliffs Nuclear Power Plant, Units 1 and 2.

(c) **Please describe monitoring and trending activities under the Reactor Building Sump Closeout Inspection program and show that they would predict the extent of degradation and allow timely corrective or mitigative actions for the applicable components in Table 3.4-4 of the LRA. If there are none, explain why. Describe the acceptance criteria and the methodology used to analyze results of inspection and testing.**

There are no trending activities under the Reactor Building Sump Closeout Inspection. It is a visual inspection; no measurements are taken. The components are found acceptable or a condition report is written and corrective actions taken in accordance with the site corrective action program. Acceptance criteria for the screens are described in the RAI response 3.3.4.3.2.4-6(b). This program is similar to the Containment Emergency Sump Inspection Procedures credited for Calvert Cliffs containment sumps and approved by the NRC in NUREG-1705, Safety Evaluation Report Related to the License Renewal of Calvert Cliffs Nuclear Power Plant, Units 1 and 2.

(d) **Discuss any past corrective actions made to the Reactor Building Sump that resulted in program enhancements. Describe any component repairs or replacements that were necessitated as a result of past reactor building sump closeout inspections.**

A review of the reactor building sump closeout inspection reports revealed that no component repairs or replacements were required. For example, the inspection in 1998 identified no observable accumulation of rust, discoloration, or other degradation of carbon steel bolts associated with valves located in the reactor building sump. Therefore, no program enhancements have been required based on operating experience.

3.3.4.3.2.5-1 Describe the inspections performed and how these activities are intended to detect the applicable aging effects. Describe the acceptance criteria and their technical basis. Identify where in the LRA is the AMR for the potential loss of preload for AAC diesel generator bolting, if not, provide a technical justification for excluding the need to manage the loss of preload or provide an AMR.

Inspections performed in accordance with the Alternate AC Diesel Generator Testing and Inspection activity are based on the manufacturer's recommendations. Use of manufacturer maintenance guides has proven effective in diesel maintenance throughout the power industry.

Please see Table 3.4-5 of the ANO-1 LRA, which indicates loss of mechanical closure integrity as an aging effect requiring management for most component commodity groupings. Alternate AC Diesel Generator Testing and Inspection is credited with managing this aging effect as discussed in Appendix B, Section 4.2.

3.3.4.3.2.5-2 **Appendix B, Section 4.13, "Maintenance Rule," cites that the Maintenance Rule Program applies to the components in Tables 3.6-1, "Reactor Building," through 3.6- 8, "Bulk Commodities." However, the Maintenance Rule Program is referenced as an AMP in most of the tables in Section 3.3, Section 3.4 (including Table 3.4-5, "Alternate AC Diesel Generator System"), and Section 3.5. Clarify this discrepancy.**

The scope of the Maintenance Rule Program is not limited to the structural components and commodities listed in Tables 3.6-1 through 3.6-8 of the ANO-1 LRA. The coatings inspections referred to in the scope paragraph of Appendix B, Section 4.13 apply to coated surfaces of many of the systems discussed in sections 3.3, 3.4, and 3.5. The Maintenance Rule Program is referenced as an aging management program for the specific components in the tables in Sections 3.3, 3.4, and 3.5. The scope section on page B-73 should have been more precise regarding the scope of the program.

3.3.4.3.2.6-1 Appendix B, Section 4.8.6, "Control Room Halon Fire Systems Inspection," describes inspection activities used to maintain the Control Room Halon Fire Systems. Please provide the following additional information:

(a) Section 2.3.3.6, Halon, of the LRA references SAR Section 9.8.2, to describe components and structures credited for Halon fire protection. These documents do not sufficiently describe the Halon System or its operation. However, from review of P&ID M-219, sheet 2, it appears that much of the Halon System piping and components are not pressurized with nitrogen or Halon gases. Table 3.4-6, Halon System of the LRA outlines aging effects and AMPs for the Halon, nitrogen, and external-ambient environments only. Please provide information about the AMPs for the portions of the Halon System that are not constantly filled with Halon or nitrogen gas.

The RAI response 3.3.4.3.1.6-1 correctly identifies the applicable aging effects for the halon system. In summary, the only applicable aging effects for the system are loss of material and cracking due to wear for the discharge tube and pilot header discharge tube flexible connections. These aging effects are managed by the Control Room Halon Fire System Inspection.

The portions of the halon system that are not constantly filled with halon or nitrogen gas may be filled with ambient air. Because this ambient air is air-conditioned, the internal surfaces of these portions of the system will not corrode and there is no aging effect (just as there is no aging effect for the external surfaces of the system that are exposed to this air-conditioned ambient environment). Thus, there is no aging management program needed to address these portions of the system.

(b) Table 3.4-6, "Halon System," of the LRA identifies the Control Room Halon Fire System Inspection to prevent loss of material internal to the parts of the Halon system where the internal fluid is nitrogen or Halon. Appendix B, Section 4.8.6, of the LRA states that the purpose of this inspection is to assure that the frequently manipulated components of the Halon system are free from the effects of aging. Please clarify how this activity addresses the internal aging effects of the components as stated in Table 3.4-6 of the LRA and how it will assure detection of aging effects before the loss of intended functions.

Please see the response to part (a) of this RAI.

(c) Appendix B, Section 4.8.6, of the LRA describes the method for Halon system inspections. Specifically mentioned is verifying nitrogen pressure, weighing Halon cylinders to determine whether loss of Halon has occurred (system leakage) and component inspections. However, Halon weight checks only indicate the integrity of the pressure boundary of the pressurized portion of the Halon system. Additionally, frequently manipulated components are inspected for aging effects but you do not; specifically state the components inspected. Please discuss the specific inspection methodology, and aging management activities for portions of the system that are not normally pressurized or the basis for not managing the effects of aging.

Please see the response to part (a) of this RAI, which clarifies aging effects requiring management for the halon system. The Control Room Halon Fire Systems Inspection includes visual inspections for signs of wear for frequently manipulated components, which are the halon system discharge tube assembly and the pilot header flexible tubing and fittings.

(d) Appendix B, Section 4.8.6, of the LRA states that inspections are performed in accordance with plant procedures, but does not identify the specific procedural requirements that demonstrate that degradation of components will be detected and corrective actions will be taken in a timely manner. Please provide this information.

Appendix B, Section 4.8.6, of the LRA states that steps in the procedure verify correct reinstallation and that the components are visually inspected during this activity. The visual inspections would detect the obvious loss of material due to wear. Please see the response to part (a) of this RAI, which clarifies aging effects requiring management for the halon system.

(e) Appendix B, Section 4.8.6, of the LRA states that acceptance criteria are provided in the Halon System inspection procedure for Halon weight and for gas pressures. Please identify any additional acceptance criteria from the Halon system inspection procedure related to loss of material, and the bases for these criteria that demonstrate the component functions will be maintained under all CLB design conditions. If no additional acceptance criteria have been established, please explain how the acceptance criteria identified in Appendix B, Section 4.8.6, of the LRA, will assure that necessary evaluations and corrective actions will be taken in response to all applicable aging effects.

Please see the response to part (a) of this RAI, which clarifies aging effects requiring management for the halon system. Procedures require a check of components that are disassembled. These components include those for which loss of material due to wear is the aging effect requiring management. The acceptance criterion is no evidence of loss of material due to wear.

(f) Appendix B, Section 4.8.6, of the LRA states that previous inspections have identified loss of nitrogen or Halon pressure and loss of Halon gas, primarily due to removal of gauges for calibration, installation of test gauges, and to seal leakage in the cylinder control heads. Describe any other types of degradation that have occurred, other than gas leakage past cylinder control head seals, to Halon system components.

The review of industry and site operating experience completed for the aging management review indicates no other types of degradation have occurred to halon system components, other than gas leakage past cylinder control head seals.

3.3.4.3.2.7 Appendix B, Section 4.21.5, "Emergency Diesel Generator Testing and Inspection," describes inspection activities used to maintain the Emergency Diesel Generator Fuel Oil Systems. Please provide the following additional information:

(a) Table 3.4-7 identifies five programs to address the aging effects in the fuel oil components. However, it does not explicitly state in the description of one of these programs, Emergency Diesel Generator Testing and Inspection in Appendix B, Section 4.21.5, of the LRA, that the program can be used for managing aging effects in the Fuel Oil System components. In its evaluation of this program, the staff assumes that it is equally applicable to the Fuel Oil

System components. Please confirm whether this assumption is valid.

This Staff's evaluation is correct. The Emergency Diesel Generator Testing and Inspection Program is used for managing aging effects on fuel oil system components. This should have been stated in the scope section on page B-99. Its absence is due to an administrative error.

(b) **Visual inspect for fuel oil leaks is performed once every 18 months per the ANO-1 Technical Specification 4.6.1. This inspection can only identify the loss of material that had progressed to the point of leakage. Failure detection is not an acceptable AMP. Therefore, inform the staff whether you considered inspection of selected susceptible locations on the internal surface of the carbon steel components of the fuel oil system to ensure that significant loss of material is not occurring, or provide a technical justification for not needing inspection activities.**

As part of the Preventive Maintenance Program (see Section 4.15 of Appendix B of the ANO-1 LRA), the emergency diesel fuel oil tanks are drained and inspected internally for loss of material. The bottoms of the tanks where water could potentially accumulate are among the locations most susceptible to corrosion. This program should have been credited in Table 3.4-7 for the component commodity grouping "tanks."

The EDG day tanks are also drained and inspected internally for loss of material. This activity should have been included within the scope of the Emergency Diesel Generator Testing and Inspection Program.

For other carbon steel components in the fuel oil system, such as piping and valves, loss of material is not expected to occur since the Diesel Fuel Monitoring Program ensures that water or other contaminants are not present in the system and the piping from the fuel oil tanks does not take suction from the bottom of the tanks (because the specific gravity of fuel oil is less than water, any water that enters or condenses in a tank will settle to the tank bottom and not travel to the rest of the system). The Diesel Fuel Monitoring Program is credited for the internal surfaces of carbon steel components in Table 3.4-7.

(c) **Discuss operating experience specific to the components of the Emergency Diesel Generator Fuel Oil Systems. Provide a general assessment of the effectiveness of the program as it relates to the operability and availability of this system. Identify any aging and/or failures detected after the implementation of the Diesel Fuel**

Oil Monitoring Program. Discuss any changes to the program brought about by operating experience.

The ANO Diesel Fuel Oil Monitoring program continues to evolve based on relevant industry and ANO-specific operating experience. The corrective action program is used to document and evaluate abnormal or unexpected aging effects that could impact the intended function of a system, structure, or component. For example, in 1996, a diesel fuel oil sample revealed out-of-specification water and sediment in the fuel oil. The corrective action program was used to document and evaluate the problem. The findings were that condensation and small amounts of water delivered in transports had been building up over time in the bottom of the fuel oil bulk storage tank. The corrective action taken included the addition of sampling from the bottom of the bulk storage tank and implementation of quarterly draining of any accumulated water from the bottom of the tank. Operating experience continues to confirm the effectiveness of the Diesel Fuel Oil Monitoring program and, when needed, changes to the program are made based on operating experience.

(d) **The current Diesel Fuel Monitoring Program was developed based on the past operating experience involving diesel fuel at ANO-1. The past experience included problems with water in the fuel, particulate contamination, and biological fouling. Describe any experience related to the loss of preload for Diesel Fuel Oil System bolting.**

Loss of mechanical closure integrity is the aging effect that can result from loss of preload. Loss of mechanical closure integrity has not been identified as a problem for the ANO-1 diesel fuel oil system bolting.

(e) **The application contains a statement that structural and component walk-downs are performed periodically, and the frequency of such walk-downs depends on the structure or component being inspected. However, the frequency at which the external surfaces of carbon steel components are inspected is not provided. Identify the maximum time between structural and component walk-downs to allow the staff to assess if the material loss on the external surface of the carbon steel components would be detected before the integrity of the pressure boundary is compromised.**

The structural walk-downs have a maximum frequency of five years. System engineers are expected to perform walk-downs on their systems at least once per refueling outage.

(f) Discuss operating experience specific to the applicable component groups managed by the Diesel Fuel Monitoring Program. Provide a general assessment of the effectiveness of the program as it relates to the operability and availability of Diesel Fuel Oil System. Describe any detection of loss of mechanical closure integrity, fouling, or loss of material that resulted in corrective actions and any failures caused by loss of mechanical closure integrity, fouling, or loss of material that were not detected by the program. Discuss any changes to this program brought about by operating experience.

The operating experience with the Diesel Fuel Monitoring Program has not identified problems with loss of mechanical closure integrity, fouling, or loss of material. As discussed in response to part (c) of this question, water and sediment in the fuel oil was detected by this program in 1996, and corrective actions were taken to prevent recurrence of this situation. The corrective actions included changes to programs as discussed in the response to part (c) of this question. The purpose of the Diesel Fuel Monitoring Program is to prevent aging effects, and it has been successful in accomplishing this purpose.

(g) Past failures detected by the Diesel Fuel Oil System are discussed, but a general assessment of the effectiveness of the program as it relates to the operability and availability of Diesel Fuel Oil System is not. In addition, there is no discussion on the effectiveness of the program to detect aging before failure occurs. Please include any changes to this program brought about by operating experience.

The Diesel Fuel Monitoring Program is a preventive program that ensures that the fuel oil is maintained free of water or other contaminants so that loss of material due to corrosion or fouling will not occur. The previous response discusses the operating experience for this program. As discussed in response to part (c) of this question, water and sediment in the fuel oil was detected by this program in 1996, and corrective actions were taken to prevent recurrence of this situation. The corrective action was taken to prevent aging effects that could impact the intended function of the system.

Other programs credited for fuel oil system components (i.e., the EDG Testing and Inspections Program, the Alternate AC Diesel Generator Testing and Inspections Program, the Maintenance Rule Program, and the Preventive Maintenance Program) have been effective in detecting aging effects before failure occurs.

3.3.4.3.2.8-1 Appendix B, Section 4.11, "Instrument Air Quality," describes sampling and testing activities used to maintain the Instrument Air Systems. Please provide the following additional information:

(a) Appendix B, Section 4.11 to the LRA states that air testing is performed in accordance with plant procedures, but does not identify the frequency and locations of testing to monitor instrument air quality, nor any trending activities. Please provide this information.

Instrument air samples are taken quarterly at the outlet of each air dryer and at the low points of each major branch. Trending to monitor the performance of the instrument air system is conducted. This information was included in the ANO-1 response to NRC Generic Letter 88-14.

(b) Appendix B, Section 4.11 to the LRA states that the results of periodic testing have verified that the instrument air quality is currently being maintained, and concludes that this provides reasonable assurance that aging effects will be properly managed.

Since the ANO-1 instrument air quality has been maintained and no age-related failures of instrument air components subject to an aging management review have occurred, operating experience provides evidence that aging effects are not occurring within these components. Thus, there is reasonable assurance that these components will continue to perform their intended functions throughout the period of extended operation.

3.3.4.3.2.9-1 Discuss operating experience specific to the Chilled Water Systems and AM Ps used. Provide a general assessment of the effectiveness of the programs as they relate to the operability and availability of Chilled Water System. Describe any detection of aging that resulted in corrective actions and any failures that were not detected by the AMPs. Discuss any changes to the AMPs brought about by operating experience.

An interview with the system engineer for the chilled water system and a search of the condition report database revealed no age-related failures specific to the chilled water system. Operating experience indicates that the Auxiliary Systems Chemistry Control Program maintains water chemistry such that aging effects are minimal in the chilled water system.

The aging management programs used for the chilled water system are listed in Table 3.4-9 of the ANO-1 LRA and are discussed further in Appendix B of the ANO-1 LRA. No changes to these programs have been made as a result of ANO-1 specific operating experience on the chilled water system.

3.3.4.3.2.9-2 Table 3.4-9 of the LRA, identifies Appendix B, Section 3.7, "Wall Thinning Inspection," as applicable to carbon steel piping, valves, thermowells, tanks and pumps in the Chilled Water System. However, the Wall Thinning Inspection Program only identifies the carbon steel components of two reactor building penetrations (numbers 51 and 59) as being applicable to the Chilled Water System. Please clarify the scope of the Wall Thinning Inspection with respect to Chilled Water System carbon steel components.

Appendix B, Section 3.7 of the LRA contains a statement that nondestructive examinations will be performed on susceptible component locations, but does not described the methods, the specific frequency of examinations, or sampling locations. Please describe the NDE methods/techniques that will be used to manage loss of material, i.e., localized and general corrosion, on applicable Chilled Water System components. Provide a discussion on the frequency of inspection and identify the maximum time allowed between inspections. In addition describe the means and the bases that will be used to determine the sampling populations.

As stated in Section 3.7 of Appendix B of the ANO-1 LRA, the Wall Thinning Inspection Program applies to the carbon steel components of penetrations 51 and 59, which are in the chilled water system. These components include piping and valves. As indicated in Table 3.4-9, the Wall Thinning Inspection Program is one of several programs credited with managing loss of material. The other programs are the Reactor Building Leak Rate Testing, ASME Section XI ISI, and Auxiliary Systems Chemistry Monitoring Program. Collectively, these programs manage the loss of material aging effect for the chilled water system.

The only portion of the chilled water system for which the Wall Thinning Inspection Program is credited is the piping and valves associated with the reactor building penetrations. Within this limited portion of the system, adequate sample locations will be chosen to provide reasonable assurance that unacceptable wall thinning is not occurring. Industry accepted methods for determining wall thickness, such as ultrasonic testing, will be used in the inspections. The frequency of the inspections will be selected to provide reasonable assurance that the piping and components are maintained above the minimum thickness necessary to assure seismic qualification. Although there is no operating experience regarding these inspections, the expected NDE methods will be consistent with commonly accepted industry practice.

3.3.4.3.2.9-3 **Appendix B, Section 3.3, of the LRA, contains a statement that the Heat Exchanger Monitoring Program will inspect heat exchangers to the extent required to ensure seismic qualification is maintained. The safety-related systems and components for which this program manages aging effects are also listed. It includes the Service Water System, the Control Room Ventilation System and the Emergency Feedwater System. No reference is made to the Chilled Water System. Please clarify the scope and applicability of the Heat Exchanger Monitoring Program as it applies to the components included in the Chilled Water System as shown in Table 3.4-9 of the LRA.**

As stated in Section 3.3 of Appendix B of the ANO-1 LRA, the Heat Exchanger Monitoring Program applies to the electrical room chillers and coolers. These components contain both service water and chilled water, and thus the program applies to both the service water system and the chilled water system. This program only manages the aging effects of loss of material and cracking, and therefore the program should not be credited for fouling in Table 3.4-9. A revised Table 3.4-9 was provided to the NRC in correspondence dated April 11, 2000 (1CAN040001).

3.3.4.3.2.10-1 Appendix B, Section 4.19, "Service Water Integrity," describes testing, visual examination, thickness mapping, and chemical control activities used to maintain the Service Water Systems. Please provide the following additional information:

(a) Appendix B, Section 4.19, "Service Water Integrity," of the LRA contains a statement that several performance monitoring tests (flow, heat transfer, etc.), visual examinations and thickness mapping activities, and chemical controls are used to manage loss of material, cracking, and fouling. Additionally, Table 3.4-10 of the LRA lists the Service Water Integrity Program for all environments, materials, commodity groups, and aging effects. It is unclear which of the activities (performance monitoring, thickness mapping, visual inspections, and chemical controls) apply to each of the commodity groups/materials/aging effects. Specifically state to which of the materials and components each of the activities in the Service Water Integrity program are targeted.

The Service Water Integrity Program is an extensive program that is designed to monitor all facets of the service water system and ensure the system is capable of performing its intended function. Implementation of this program, which includes testing, nondestructive examinations, and chemical controls, fulfills commitments made under the current licensing basis in response to NRC Generic Letter 89-13.

Under this program, performance testing, nondestructive examinations, and chemistry control activities are performed for the service water system carbon steel piping, strainers, and valves, the stainless steel piping, flow elements, thermowells, and valves; the carbon steel and stainless steel service water pump casings; and the service water side of heat exchangers (includes carbon steel, stainless steel, copper, 90-10 copper nickel, and admiralty components). Inspections are performed for the sluice gates (gray cast iron with some stainless steel subcomponents) and the brass and bronze valves.

Performance testing, nondestructive examinations, and chemistry control activities manage loss of material and cracking of the carbon steel, stainless steel, cast iron, brass, bronze, copper, 90/10 Cu-Ni, and admiralty components. Performance testing and chemistry control elements of the Service Water Integrity Program manage the aging effect of fouling on the copper, stainless steel, 90/10 Cu-Ni, and admiralty components.

(b) Describe the specific performance parameters used for the flow tests, heat exchanger tests, and pump and valve/sluice gate tests

applied to each component in the Service Water System as part of the Service Water Integrity Program. Verify that all of these performance tests are targeted to manage fouling (and not loss of material or cracking) and describe how the parameters monitored will ensure the intended function of each component tested. In addition, state the frequencies and sampling parameters of each tests and describe any trending associated with the tests that would predict the extent of fouling,

The specific performance parameters used for flow testing, heat exchanger testing, pump testing, and sluice gate testing are component-specific. Descriptions of these parameters, including their specific values, are documented in site procedures and instructions. Most of these tests are focused on managing fouling (the exception is testing of the sluice gates and boundary valves for leakage, which is used to identify loss of material or cracking). For instance, flow rate testing is performed once per refueling outage to ensure that fouling does not reduce the flow rates to individual components below the required values. Heat exchanger testing and inspections are used to ensure that fouling does not prevent heat exchangers from removing the necessary heat load. Test results are monitored to determine if flow rates or heat transfer rates are gradually declining and whether corrective action must be taken. These activities have been accepted under the current licensing basis as adequate to ensure the aging effect of fouling is adequately managed. Addition detail can be found in the Entergy Operations response to Generic Letter 89-13, dated January 26, 1990 (0CAN019012).

(c) **Describe the nondestructive examination methods/techniques used for piping wall thickness mapping as part of the Service Water Integrity Program. List the components and materials to which these examinations apply. In addition, describe the bases and extent of sampling (locations examined), and expansion criteria, with respect to the total population of applicable components. Finally, describe how monitoring or trending of inspection data results in the timely detection of aging effects that might compromise the intended pressure boundary function of piping in the service water system.**

Thickness mapping of carbon steel piping at selected locations in the service water system is performed using automated ultrasonic inspection. The initial selection of inspection locations considered potential aging effects, flow conditions, and piping stresses. This data in conjunction with flow testing data is used in determining the need for system pipe replacement. This program has been effective in ensuring replacement prior to failure of the piping. Under the Service Water Integrity Program, most of the system piping has been replaced in recent years as part of the continuing upgrades of the service water system. Due to the recent piping replacement and use of improved corrosion inhibiting chemicals, extensive thickness mapping is not required at this time.

(d) List the components subject to visual inspection as part of the Service Water Integrity program and describe the type of visual inspections used in relation to the applicable aging effect they are intended to manage.

The components subject to visual inspection are switchgear room coolers, makeup pump lube oil coolers, reactor building spray pump lube oil coolers, decay heat removal pump bearing coolers, control room emergency chillers condensing units, reactor building coolers, makeup pump room coolers and decay heat room coolers. Tube-side visual inspections specifically check for fouling and loss of material. Additional information regarding inspection activities associated with the Service Water Integrity Program is contained in the Entergy Operations to NRC correspondence dated February 17, 2000 (0CAN020001).

(e) Visual inspections of safety-related components, (e.g., valves, sluice gates, and heat exchanger tubing) is used to manage cracking. Describe how a visual inspection can detect cracking before the pressure boundary function of these components is compromised.

ANO-1 has not experienced cracking of stainless steel, brass, or bronze components exposed to service water because of the low temperature of the water and the use of low carbon stainless steel. This is consistent with NPRDS industry failure data that indicates stress corrosion cracking of stainless steel, brass, or bronze components in a fresh water lake environment is not likely. Based on this information, cracking of stainless steel, brass, or bronze components is considered an unlikely aging effect for the ANO-1 service water system. This is consistent with the NRC Staff review of the Oconee Nuclear Station documented in Section 3.6.1.3.1 of NUREG-1723, Safety Evaluation Report Related to the License Renewal of Oconee Nuclear Station, Units 1, 2, and 3, which indicated that loss of material and fouling are the applicable aging effects for stainless steel, brass, and bronze components exposed to service water.

Table 3.4-10 of the ANO-1 LRA conservatively included cracking as an aging effect for certain components. Section 4.19 of Appendix B should have credited chemical control as well as visual inspections to manage the effect of cracking. Based on operating experience, these aging management activities would be adequate to prevent (chemical control) and to detect (visual inspection) cracking.

(f) **Acceptance criteria for all performance monitoring, wall thickness mapping, visual inspections, and chemistry control activities are in site procedures. Please describe these acceptance criteria and any methods for analyzing the results of the stated activities against industry standards. Describe corrective actions that would occur prior to compromising the intended function of each component in the service water system.**

For the system flow test, the acceptance criteria are measured flows above minimum flow requirements. Minimum flow requirements are adjusted to account for projected degradation between flow tests. For verification of flow to the reactor building coolers, acceptance criteria are based on safety analysis assumed flows and system hydraulic conditions. For the sluice gates, leakage must be less than the maximum allowable.

Wall thickness mapping is performed and evaluated to ensure pipe wall thickness does not drop below minimum allowable. Corrective actions would typically consist of piping replacement before wall thickness is projected to fall below the minimum required.

ASME Section XI visual inspections are performed by qualified inspectors and indications are evaluated using the guidance in ASME Section XI. Corrective actions will be in accordance with the applicable code requirements. Also, service water system chemistry control activities are discussed in the RAI response 3.3.1.1-1(a).

(g) **Discuss operating experience specific to the service water systems and AMPs including the Service Water Integrity and ASME Section XI-IWC and IWD used. Provide a general assessment of the effectiveness of the programs as they relate to the operability and availability of the service water system. Describe any detection of aging that resulted in corrective actions and any failures that were not detected by the AMPs. Discuss any changes tot he AMPs brought about by operating experience.**

The ongoing performance and condition monitoring programs for the service water system are effective in managing applicable aging effects. During the 1980's, degradation due to fouling and loss of material was identified in the ANO service water system. In response to the identified degradation, Entergy Operations implemented the Service Water Integrity Program.

Inspections and tests performed in accordance with the Service Water Integrity Program and the ASME Section XI ISI-IWC and -IWD Programs have been effective in identifying deficiencies and degrading trends that could impact the capabilities of the service water system. When deficiencies are identified, appropriate corrective actions are performed.

Since the early 1980's, significant modifications to the service water system have been implemented in response to identified age related degradation. Some of the most significant items include:

- System Pipe Replacement - Much of the carbon steel piping less than four inches in diameter was replaced with stainless steel piping. The stainless steel piping is much less susceptible to fouling and loss of material. Large-bore pipe replacement has been accomplished to address fouling and loss of material. The results of the service water pipe thickness mapping under the Service Water Integrity Program are used to prioritize the piping to be replaced. Approximately 1000 feet of large bore piping in the service water system has been replaced like-for-like with carbon steel piping.

- Service Water Chemical Addition Systems - New chemical addition systems for biocide treatment and corrosion control of the service water system were installed. These systems have proven effective in controlling biofouling and reducing system piping corrosion rates.

- Service Water Pump Upgrades - The shaft sleeves have been upgraded with a harder material to improve wear resistance and decrease required maintenance. The bowl assemblies and impellers were upgraded to stainless steel components due to erosion of components that led to degraded performance.

- Emergency Cooling Pond (ECP) Return Line Coating – The return line to the ECP was cleaned and coated with an epoxy coating to reduce corrosion and fouling. The line is inspected each refueling outage. The inspections have concluded that the coating has been effective in reducing fouling and corrosion in the ECP return line.

Ongoing performance and condition monitoring programs and activities have proven effective in managing the aging effects of fouling and loss of material in the service water system.

3.3.4.3.2.10-2 Appendix B, Section 3.3, of the LRA, contains a statement that the Heat Exchanger Monitoring Program will inspect the heat exchangers to the extent required to ensure seismic qualification is maintained and that this program addresses cracking and loss of material. However, Table 3.4-10 of the LRA indicates that the heat transfer function is affected by fouling and fouling will be managed by the Heat Exchanger Monitoring Program. Please clarify the purpose and scope of the Heat Exchanger Monitoring Program as it applies to the components shown in Table 3.4-10 of the LRA.

The description of the Heat Exchanger Monitoring Program in Section 3.3 of Appendix B of the ANO-1 LRA is correct in that the program only addresses cracking and loss of material. The Heat Exchanger Monitoring Program does not address fouling, and thus all cases where this program has been credited for fouling are incorrect due to administrative error in assembling the tables (specifically, Table 3.3-2, Low Pressure Injection/Decay Heat Removal System, heat exchangers (DHR coolers); Table 3.4-9, Chilled Water System, heat exchangers (evaporators); and Table 3.4-10, Service Water System, heat exchangers). The aging management review identified other aging management programs that are listed in the tables and that are adequate to manage fouling for the applicable materials and environments.

3.3.4.3.2.11-1 Table 3.4-11, "Penetration Room Ventilation System," of the LRA identifies Penetration Room Ventilation System Testing Program as one of the programs that prevents loss of material to the exhaust stack in the external-ambient environment. However, a discussion of the Penetration Room Ventilation System Testing Program could not be found in the LRA. Please describe the system testing performed to manage the effects of aging consistent with the information provided in Appendix B to the LRA, and the information requested in the auxiliary systems RAIs.

Table 3.4-11 was incorrect with regard to listing the Penetration Room Ventilation System Testing Program as an aging management program for managing loss of material of the external surfaces of the carbon steel exhaust stack, due to an administrative error. However, the aging management review did identify, as is listed in Table 3.4-11, the Maintenance Rule Program as an aging management program for this component and environment. This program is described in Appendix B, section 4.13, and will adequately manage the loss of material aging effect for the external surfaces of the exhaust stack. Please see the response to RAI 3.3.4.3.2-9(a) regarding the scope of the Maintenance Rule Program.

3.3.4.3.2.13-1 Table 3.4-13 of the LRA identifies the Control Room Ventilation Program as the AMP used to manage loss of material on the internal surface of the carbon steel bodies of the evaporators. However, Appendix B, Section 4.21.3 identifies fouling on the external surface of the cooling coil tubes as the only aging effect managed by the Control Room Ventilation Program. Please identify the AMP used to manage the loss of material on the internal surface of the carbon steel bodies of the evaporators. Describe this program consistent with the information provided in Appendix B to the LRA, and the information requested in the auxiliary systems RAIs.

Table 3.4-13 of the ANO-1 LRA is incorrect with regard to listing the Control Room Ventilation Testing Program as an aging management program for managing loss of material of the internal surfaces of the carbon steel housings of the evaporators due to administrative error. However, the aging management review did identify, as is listed in Table 3.4-13, the Preventive Maintenance Program as an aging management program for this component and environment. This program, as described in Appendix B, section 4.15, will adequately manage the loss of material aging effect for the internal surfaces of the evaporator housings.

3.3.4.3.2.13-2 Table 3.4-13 identifies the Oil Analysis Program as the program used to manage loss of material for both carbon steel compressor and condenser (heat exchanger) bodies exposed to lubricating oil. However, Appendix B, Section 4.14, of the LRA, which describes this program, includes the control room ventilation compressor but not condenser within its scope. Please identify the AMP used to manage the loss of material for the condenser body. Describe this program consistent with the information provided in Appendix B to the LRA, and the information requested in the auxiliary systems RAIs.

The control room emergency condensers are not subject to a lube oil environment, and thus Table 3.4-13 of the ANO-1 LRA was incorrect due to administrative error in listing lube oil as an environment for these condensers. The condensers contain 90-10 copper nickel tubes with freon flowing inside the tubes. Based on this material and environment, there are no aging effects requiring management for the inside of these tubes for both the pressure boundary and heat transfer intended functions. This conclusion is consistent with industry and site operating experience.

In these condensers, the freon is cooled by service water which flows on the outside of the tubes. The outside of the tubes and the carbon steel condenser housing, which are exposed to service water (i.e., raw water), are evaluated in Table 3.4-10 as part of the service water system under the component commodity grouping "heat exchangers."

3.3.5-1 **Section 3.5.1 of the application states that the steam and power conversion systems are exposed to treated water, lube oil, nitrogen, air, and ambient atmosphere. Are the components of the condensate storage and transfer system also exposed to an environment of raw water? In the condensate storage and transfer systems of similar plants, the secondary side of the main condensers and condensate coolers are in contact with raw water. If these components are exposed to raw water then loss of material due to general corrosion and fouling are applicable aging effects that should be addressed.**

The condensate storage and transfer system components, including the suction header for the emergency feedwater pumps, are not normally exposed to a raw water environment but can physically take suction from the service water system and may during emergency conditions. However, this emergency supply is not used as the normal supply for emergency feedwater. A normally depressurized and vented section of the connecting piping from the service water system ensures that raw water does not enter the suction header for the emergency feedwater pumps. Therefore, for the aging management review, the internal environment for the in-scope portions of the condensate storage and transfer system and the emergency feedwater system is treated water (i.e., demineralized water). The portion of the condensate storage and transfer system within the scope of license renewal does not include the main condenser or any condensate coolers as shown on drawing LRA-M-204, sheets 3 and 5.

3.3.5-2 **Do the components of the steam and power conversion systems have two types of materials jointed together, such as carbon steel jointed with stainless steel? If so, identify the components that makeup connections involving dissimilar metals. Identify the components potentially affected by the loss of material due to galvanic corrosion and describe how the aging effects due to galvanic corrosion is managed during the period of extended operation.**

The components of the steam and power conversion systems do have cases where two types of materials are jointed together and, thus, may be subject to galvanic corrosion.

In the main steam system, galvanic corrosion may occur where the stainless steel instrument piping and valves connect to the carbon steel piping if a liquid internal environment is present. In the emergency feedwater system, the carbon steel piping joined to stainless steel components, such as the expansion joints, the solenoid valves, the steam supply valve, and the flow orifice, could experience galvanic corrosion of the internal surface if water is present. In the condensate storage and transfer system, galvanic corrosion may occur at the carbon steel (EFW suction header piping) to stainless steel (piping from the Q-condensate storage tank) interface and at the carbon steel piping near the stainless steel instrument valve.

The aging effect associated with galvanic corrosion is a loss of material. Tables 3.5-1, 3.5-3, and 3.5-4 of the ANO-1 LRA indicate that loss of material is an aging effect for carbon steel piping in the main steam system, emergency feedwater system, and condensate storage and transfer system, respectively, and list the programs and activities that manage this aging effect.

3.3.5-3 **The emergency feedwater system contains valve components made of cast iron. Address the aging effects of selective leaching in these cast iron components and describe how the aging effects due to selective leaching of cast iron components will be managed during the period of extended operation. Also address the plausible aging mechanism of pitting corrosion in these components and how this aging effect will be managed during the period of extended operation.**

The emergency feedwater system contains one valve made of cast iron in the emergency feedwater lubricating oil subsystem. This valve is exposed to lube oil internally and the ambient environment externally. For purposes of the aging management review, this valve is assumed to be gray cast iron. Selective leaching is an aging mechanism for gray cast iron in a lube oil or external ambient environment only if moisture is present.

For the interior surface of the cast iron EFW lubricating oil valve, loss of material is an applicable aging effect, as indicated in Table 3.5-3 of the ANO-1 LRA, since it is possible for lubricating oil to be contaminated with water. However, because the Oil Analysis Program ensures that the lubricating oil is maintained free of water, loss of material due to selective leaching on the internal surface of the valve will not occur. Thus, this aging management program prevents this aging effect. Operating experience has shown that the oil analysis program maintains lubricating oil free of water.

For the exterior surface of the cast iron EFW lubricating oil valve, loss of material due to selective leaching is not an applicable aging effect since the valve is located indoors and is protected from the weather, and thus is not subjected to moist air.

Loss of material due to pitting corrosion of cast iron could occur in the presence of water and other contaminants. As shown in Table 3.5-3, loss of material of the cast iron valve is managed by the Oil Analysis Program. Because this program ensures that the lubricating oil environment in mechanical systems is maintained free of water and other contaminants, pitting corrosion is not expected on the internal surfaces of the cast iron valve. Additionally, because the cast iron valve is located indoors and is protected from the weather, pitting corrosion is not expected on the external surfaces of the valve.

3.3.5-4 **Table 3.5-1 identifies an augmented ISI special inspection program of Q stainless steel piping. Explain the term "Q stainless steel piping." Describe the aging effects associated with "Q stainless steel piping" and describe how the augmented ISI program meets the ten point criteria for an effective AMP.**

The only portion of the main steam system piping that is safety-related or "Q" is the portion of the piping between the steam generators and the main steam isolation valves including the steam supply to the EFW turbine. The only stainless steel piping in this portion of the system is a limited amount of ¾" piping serving wide range level instrumentation. The term "Q stainless steel piping" refers to this safety-related stainless steel piping in the main steam system. Loss of material, cracking, and loss of mechanical closure integrity are considered applicable aging effects for the Q stainless steel piping.

The majority of the safety-related main steam system piping is ASME Class 2, which is controlled by the ASME Section XI Code Article IWC-1000 and subject to IWC inspections. The Q stainless steel piping is not subject to IWC inspections, but is subject to augmented inspections.

The attributes of the Augmented Inspections Program are described in Section 4.3.7 of Appendix B of the ANO-1 LRA. This program is one of several aging management programs used to manage the aging effects on the stainless steel piping in the main steam system.

3.3.5-5 **Table 3.5-4 identifies a condensate storage tank level monitoring program as the AMP to manage the aging effect of loss of material.**

Identify which specific aging management program listed in Section 3.5.3 that describes this program. Also describe how this AMP manages the effects of aging. If it is intended to monitor the loss of tank fluid level due to leakage caused by loss of material, then that program is being used as failure detection and not aging management. An AMP is expected to limit or monitor the loss of material to ensure that minimum wall thickness is maintained consistent with the CLB to prevent leakage from occurring.

Due to an administrative error, Table 3.5-4 of the ANO-1 LRA incorrectly identifies the Condensate Storage Tank Level Monitoring activity as a means to manage the aging effect of loss of material. The other aging management programs listed in Table 3.5-4 that address the aging effect of loss of material are sufficient to manage this aging effect. Specifically, for internal surfaces of carbon steel piping, tubing valves and appurtenances, the Wall Thinning Inspection, ASME Section XI ISI-IWD (pressure tests), and the Secondary Chemistry Monitoring Program manage loss of material. For the carbon steel external components of the safety related condensate storage tank, the Maintenance Rule Program and ASME Section XI ISI-IWD (pressure tests) manage loss of material and loss of mechanical closure integrity. Note that the carbon steel components of this tank are the bolts and hex nuts on the manways.

3.3.5-6 **Section 3.5.3 of the LRA does not identify aging due to mechanical vibration as an applicable aging effect. Industry operating experience has identified cracking from mechanical vibration as a potential aging effect for the piping system components in the steam and power conversion systems. Identify where in the LRA is this aging effect addressed. If not, provide a justification as to why cracking from vibration is not a potential aging effect at ANO-1.**

Consistent with Oconee's position on cracking due to vibrational (mechanical or hydrodynamic) loads, Entergy Operations determined that this potential aging effect was not applicable to the ANO-1 steam and power conversion system components subject to an aging management review. Cracking due to vibration can be attributed to inadequate design. Vibration characteristically leads to cracking in a short period of time, on the order of hours to days of operation. For example, a component with a 1 Hz vibratory load will be subjected to 10^7 cycles in four months of service, so that failure is probable early in life for vibratory stresses above the endurance limit. Because this time period is short compared to the overall plant life, cracking will be identified and corrected to prevent recurrence long before the period of extended operation. Therefore, cracking due to vibrational loads, both mechanical and hydrodynamic, is not an applicable aging effect for the ANO-1 steam and power conversion system components subject to an aging management review. Additionally, in Section 3.7.3.1 of the Safety Evaluation Report Related to the License Renewal of Oconee Nuclear Station, Units 1, 2, and 3 (NUREG-1723), the following statement is made, "The [NRC] staff concurs with the applicant's assessment and conclusion that mechanical vibration is not an applicable aging effect for the piping systems in the [steam and power conversion systems]."

3.3.5-7 **Pitting and crevice corrosion were also not identified as a potential aging effect for piping flange connections that are part of the steam and power conversion systems in Section 3.5. Identify where in the LRA this aging effect is addressed.**

Pitting corrosion and crevice corrosion are aging mechanisms that result in a loss of material. The steam and power conversion systems components are susceptible to these aging mechanisms though the effects of these aging mechanisms are minimized by maintaining low levels of contaminants and oxygen through implementation of the Secondary Chemistry Monitoring Program. Section 3.5.2 and Tables 3.5-1 through 3.5-4 of the ANO-1 LRA identify loss of material as an applicable aging effect for the steam and power conversion systems. The noted tables also list the programs that manage this aging effect.

3.3.5-8 **In the course of operation, there are often problems or issues related to aging effects that were not anticipated and there was no discussion of an operating history review being performed in Section 3.5. Describe the plant-specific and industry operating history reviews and results used to identify the potential aging effects associated with the steam and power conversion systems.**

Section 3.5.4 of the ANO-1 LRA indicates that operating history and plant-specific reviews were performed for the purpose of identifying potential aging effects associated with the steam and power conversion systems. These reviews identified the potential for weld cracking and wall thinning (loss of material) as a result of erosion-corrosion, including flow-accelerated corrosion. These aging effects (cracking and loss of material) were considered during the conduct of the aging management reviews for the steam and power conversion systems and are listed in Section 3.5.2 of the ANO-1 LRA as aging effects requiring management.

3.3.5-9 **With respect to the wall thinning program described in Section 3.7 of Appendix B, please provide the following information:**

(a) Describe the aging mechanisms in sufficient detail to allow the staff to assess the adequacy of the AMP.

In general, the aging mechanisms for wall thinning (loss of material) include:

- General corrosion of internal carbon steel and chrome-moly surfaces due to oxygenated water
- Erosion/corrosion of carbon steel components if high velocity flow exists
- Crevice and pitting corrosion of carbon steel and chrome-moly components due to oxygenated water or high chlorides and stagnant conditions
- Galvanic corrosion if carbon steel components are adjacent to dissimilar metals in the presence of oxygenated water

The wall thinning inspection does not apply to stainless steel components.

(b) Is loss of material an applicable aging effect of the main feedwater and condensate storage and transfer systems? If so, explain why the main feed water system and the condensate storage and transfer systems are not addressed by this program.

Loss of material is applicable to the main feedwater system and the condensate storage and transfer system. The Wall Thinning Inspection is not credited for the main feedwater system because other programs are credited as shown on Table 3.5-2 of the ANO-1 LRA. For loss of material due to erosion/corrosion, the Flow Accelerated Corrosion Prevention Program is specifically credited. In Section 3.7 of Appendix B on page B-19, the last bullet under emergency feedwater system, which says: "Carbon steel emergency feedwater supply header piping and valves (condensate supply)" should be indicated as in the condensate storage and transfer system as shown on drawing LRA-M-204, sheet 3. As indicated in Table 3.5-4, the Wall Thinning Inspection is credited for carbon steel piping, tubing, valves and appurtenances in the condensate storage and transfer system.

(c) The program indicates that the sample size for the inspections will be determined based on the operating experience prior to these inspection activities. Explain what operating experience will be used if there are no previous results of similar inspections. Also

provide details on how the samples and sample sizes are determined.

Prior to performing the first inspection, Entergy Operations intends to search the condition report database for documented previous wall thinning. We will also review operating experience for wall thinning issues experienced in the industry. Then we will inspect a sample of equipment to determine the extent of wall thinning at ANO-1 at the time of program implementation. The population from which the sample will be selected includes components in the emergency feedwater system, the chemical addition (sodium hydroxide) system, the main steam system, the reactor building isolation system and the condensate storage system. If significant wall thinning is found, the sample size will be expanded to determine the extent of the issue and the sample schedule would take into account the rate of expected degradation. Sample sizes will be chosen to provide reasonable assurance that the population is not significantly affected by the degradation mechanism. This is consistent with the method used in the Age Related Degradation Inspection Program described in the Calvert Cliffs LRA. The NRC Staff found it acceptable in NUREG-1705. Although there is no operating experience regarding these inspections, the elements that comprise the inspections (e.g., the scope of the inspections and the inspection techniques) are consistent with common industry practice.

(d) **This program suggests that because the results of visual inspections have been effective in managing the effects of aging, the new wall thinning inspection program based on non-destructive examinations that are not visual will also be effective. Explain the basis for this conclusion.**

The application should have indicated in the demonstration paragraph on page B-20 that non-destructive testing has been effective in managing the effects of aging at ANO-1. It should read: "The ANO-1 history of successful operation demonstrates that non-destructive testing has been effective in managing the effects of aging on components."

3.3.5-10 With respect to the bolting and torquing activities program described in Section 4.4 of Appendix B, the LRA indicates that the acceptance criterion is "no loose fasteners." Describe how this criterion is evaluated. For example, is this based on samples of bolts that will be tested by torque determinations or by measurements of the breakaway torque?

The ANO-1 LRA Bolting and Torquing Activities program acceptance criteria are stated as follows:

"Acceptance criteria are provided in the ANO site procedures. Typical criteria are that mating surfaces are smooth and free of major defects. Male and female threads are inspected for major defects (nicks, burrs, evidence of galling, etc.). Other criteria include proper and adequate thread engagement, no loose fasteners, and use of appropriate torque values."

Checks for loose fasteners are accomplished by verifying that the fasteners are at least snug tight. Snug tight is the condition of tightness where all mechanical slack has been removed from the mating surfaces of the bolted joint and the fasteners, but a specific amount of fastener tensioning (elongation or "stretching") is not required. For those fasteners with installed locking devices, a visual inspection is performed to detect any evidence of loosening such as deformation of the locking device, air gaps or misalignment of the bolted joint, etc. No installed fastener locking devices shall be removed or deactivated to check for fastener looseness unless specifically required by the job order package.

3.3.5-11 With respect to the secondary chemistry monitoring program described in Section 4.6.2 of Appendix B, provide the following information:

(a) Table 3.5-1 and 3.5-3 identifies the secondary chemistry monitoring program as an AMP for the main steam system and the emergency feedwater system; these systems are not discussed in Section 4.6.2 of the LRA. Explain this discrepancy and identify where these programs are discussed in association with the secondary chemistry control program.

The secondary chemistry monitoring program does apply to the main steam and emergency feedwater systems as indicated in Table 3.5-1 and Table 3.5-3 of the ANO-1 LRA. The second sentence in the scope discussion in Section 4.6.2 of Appendix B of the ANO-1 LRA encompasses these systems. It reads as follows:

"The aging reviews for many of the safety-related, non-class 1 systems also indirectly credit the Secondary Chemistry Monitoring Program since the condensate storage tanks are used as a source of makeup water to these systems." The main steam and emergency feedwater systems are safety-related, non-class 1 systems. Not specifically addressing the main steam and emergency feedwater systems in the scope discussion in Section 4.6.2 of Appendix B was an administrative oversight.

(b) The program does not clearly describe the activities for prevention and mitigation of the aging effects. For example, the program refers to 'adequate processes' to assure aging effects are mitigated, but does not identify these processes. The program also refers to 'allowable values' and 'allowable ranges' without any discussion as to the basis for those values and ranges. Describe the secondary chemistry control program particularly as it applies to the Main Steam and Emergency Feedwater Systems using the ten elements for an AMP from the standard review plan in sufficient detail to allow the staff to adequately evaluate the program's adequacy.

As stated in the response to part (a) of this question, the main steam and emergency feedwater systems should have been included in the scope discussion of Section 4.6.2 of Appendix B as is indicated in Tables 3.5-1 and 3.5-3. Thus, the description of the Secondary Chemistry Monitoring Program in Section 4.6.2 of Appendix B specifically applies to the main steam and emergency feedwater systems.

The Secondary Chemistry Monitoring Program is part of ANO-1's current licensing basis and is specifically required by Facility Operating License DPR-51 Section 2.c(7). This program prevents and mitigates aging effects by ensuring that the levels of contaminants and oxygen in the steam and power conversion systems within the scope of license renewal are maintained at low levels. The specific levels that are maintained in these systems are based on the EPRI PWR Secondary Water Chemistry Guidelines and other industry standards. ANO-1 and industry operating experience have shown that maintaining secondary water chemistry in accordance with these guidelines and standards is effective in minimizing the effects of aging on secondary system components.

Additional demonstration of the effectiveness of this aging management program is provided in the following discussion. In the most recent NRC inspection of the ANO-1 water chemistry programs (NRC

Inspection Report 50-313/96-12), the Staff found the water chemistry programs were properly implemented by a well trained and qualified staff and several strengths were identified. Chemistry laboratory instruments and in-line process instruments were properly calibrated and maintained. The inspection determined an excellent chemistry data management system was maintained. The inspectors reviewed the water chemistry results over a two-year period. Very few out of specification chemistry conditions were noted and these were promptly corrected and brought to within the applicable limits in accordance with EPRI guidelines.

Entergy Operations also has a procedure for conducting chemistry inspections of plant systems and heat exchangers. This procedure outlines inspection methods for checking for corrosion, deposits, structural damage, general cleanliness, appearance, and biological growth. Inspections are frequently completed of components and systems that are available for inspection due to routine or corrective maintenance. These inspections help to verify the adequacy of the existing chemistry controls and ensure unanalyzed degradation is not occurring.

(c) The program refers to 'contaminants' as monitored parameters but does not identify them, e.g., sodium chloride, etc. Please identify the contaminants referred to in the program description.

The monitored parameters include dissolved oxygen, sodium, chloride, sulfate, and silica.

(d) The program refers to 'EPRI guidelines.' Does this refer to the EPRI "Secondary Water Chemistry Guidelines" (TR-102134, Rev. 3)?

The Secondary Water Chemistry program is based on the PWR Secondary Water Chemistry Guidelines, EPRI TR-102134,however, the program was recently revised based on Revision 4 of the EPRI guidelines.

3.3.5-12 **With respect to the flow accelerated corrosion prevention program described in Section 4.9 of Appendix B, provide the following information:**

(a) The flow accelerated corrosion prevention program applies to main feedwater and main steam systems. Why is the condensate

storage and transfer system not also covered by this program as indicated by Table 3.5-4?

Loss of material due to erosion-corrosion is not applicable for the portion of the condensate storage and transfer system within the scope of license renewal shown on drawing LRA-M-204, sheets 3 and 5. The safety-related condensate storage tank and the piping and valves between the tank and the EFW suction header are not susceptible to loss of material due to erosion-corrosion since these components are constructed of stainless steel and the water contained in these components is normally stagnant. Loss of material due to erosion-corrosion of the carbon steel EFW suction header components is not expected since the water in these components is not normally flowing. Because of aging mechanisms other than erosion-corrosion, Table 3.5-4 of the ANO-1 LRA indicates that loss of material is an aging effect that is applicable to the carbon steel EFW suction header components and includes the wall thinning inspection program (not the flow accelerated corrosion prevention program) as one of the programs to manage this aging effect.

(b) **The program does not identify preventative/mitigative actions such as water chemistry adjustments to control erosion/corrosion. Describe the preventative/mitigative activities built into this program. If the program does not contain preventative/mitigative activities, please provide a justification for not including these elements in the Accelerated Corrosion Prevention Program.**

The Flow Accelerated Corrosion Prevention Program at ANO-1 does not include preventive or mitigative activities. Instead, this program is a detection program and includes predicting susceptible component locations, conducting ultrasonic and visual inspections, and performing trending activities. Flow accelerated corrosion can be mitigated to some degree by controlling water chemistry, which is achieved by the Secondary Chemistry Monitoring Program. For the two ANO-1 systems that are susceptible to flow accelerated corrosion (i.e., the main steam and main feedwater systems), both the Flow Accelerated Corrosion Prevention Program and the Secondary Chemistry Monitoring Program are used to manage loss of material due to flow accelerated corrosion. Table 3.5-1 of the ANO-1 LRA for main steam and Table 3.5-2 for main feedwater both list the Flow Accelerated Corrosion Prevention Program and the Secondary Chemistry Monitoring Program as aging management programs for carbon steel components. The Flow Accelerated Corrosion Prevention Program is based on industry standards for managing flow accelerated corrosion and is similar to the erosion/corrosion aging management programs approved in NUREG-1705, Safety Evaluation Report Related to the License Renewal of Calvert Cliffs Nuclear Power Plant, Units 1 and 2, and NUREG-1723, Safety Evaluation Report Related to the License Renewal of Oconee Nuclear Station, Units 1, 2, and 3.

(c) **The acceptance criteria cite the ASME B31.1 Code design minimum wall thickness as a thickness below which corrective actions must be taken. However, the program description does not discuss trending of wall thickness to determine the rate of wall thickness loss so that continued operation will not reduce the wall thickness below the design minimum.**

The Flow Accelerated Corrosion Prevention Program projects wall thinning based on trending. The ANO-1 program trends the rate of material loss based on ultrasonic inspection data to project when wall thickness may be reduced to less than the design minimum. Any wall thickness that is projected to be below 70% of nominal wall at the next refueling outage is evaluated to determine if additional areas need to be examined. Any component that is projected to be below the ASME B31.1 minimum wall thickness before the next refueling outage is replaced unless an evaluation of wall thinning in the local area can show acceptability for continued service.

3.3.5-13 **With respect to the emergency feedwater pump testing program described in Section 4.21.6 of Appendix B, the LRA indicates that the aging effects of fouling, loss of material, and loss of mechanical closure integrity are identified by verifying that each pump operates through a test loop path. Describe the program using the ten elements for an AMP from the standard review plan in sufficient detail to allow the staff to adequately evaluate the programs adequacy. Include an explanation on how flow testing through a test loop can identify each of these three aging effects throughout the applicable portions of the system. Also identify which system components are affected by this program.**

A description of the Emergency Feedwater Pump Testing Program that is correlated with the ten elements for an aging management program from the draft NRC standard review plan is provided below. This aging management program is one of the activities listed in Table 3.5-3 of the ANO-1 LRA to detect fouling, loss of material, and loss of mechanical closure integrity. It is not the sole method of managing these aging effects for the emergency feedwater system (see Table 3.5-3).

Scope of Program: The scope of the Emergency Feedwater Pump Testing Program includes the turbine and electric motor driven emergency feedwater pumps and associated components. Specifically, since the test loop flow path is a full flow test loop that taps off just downstream of check valves FW-55A, FW-55B, FW-56A, and FW-56B (refer to drawing LRA-M-204, sheet 3), the program directly applies to these check valves and system components upstream of them, which encompasses the large majority of the emergency feedwater flow path. Because the aging management review did not identify any unique aging effects for the components not directly in the test flow path, the test results for components in the test flow path are representative of components in both the tested and non-tested emergency feedwater flow path. In addition to the monthly test flow path, this testing program includes a functional test of the entire loop to the steam generators every 18 months. Therefore, the entire system is included in the 18 month testing activity.

The program also applies to the carbon steel steam supply and exhaust components associated with the turbine driven emergency feedwater pump, the turbine lube oil cooler, carbon steel components that provide cooling and seal water to the emergency feedwater turbine and pump, and the emergency feedwater pump bearing coolers.

Preventive Actions: The Emergency Feedwater Pump Testing Program is a detection program and does not provide activities for prevention or mitigation.

Parameters Monitored or Inspected: The parameters that are monitored during the conduct of the emergency feedwater pump tests include emergency feedwater pump discharge pressure and flow and the temperatures of the turbine lube oil and the pump bearings. As part of the testing, operators observe the condition of operating equipment and systems, identify unusual or unexpected situations or conditions which warrant close attention or corrective action, greater than expected leakage, and other signs of unacceptable system or component age related degradation.

Detection of Aging Effects: Abnormally high temperature of the turbine lube oil or a pump bearing is an indication of fouling. Visual indications of adverse or potentially adverse trends in equipment operation, water or oil on floors or components, are indications that loss of mechanical closure integrity or loss of material may have occurred.

Monitoring and Trending: Each emergency feedwater system train is tested at least quarterly. Any abnormal indications during the conduct of emergency feedwater pump testing are evaluated and appropriate corrective actions in accordance with the ANO-1 Corrective Action Program are taken, if necessary. These corrective actions may include additional inspection, monitoring, or trending activities.

Acceptance Criteria: The acceptance criteria for operator observations of operating equipment is no abnormal or greater than expected leakage from plant systems or components as evidenced by water or oil on the floor, as described in plant procedures. The acceptance criteria for emergency feedwater pump discharge pressure and flow are provided in ANO-1 Technical Specification 4.8. The acceptance criteria for the temperatures of the turbine lube oil cooler and the pump bearing coolers is that the temperatures remain within the normal operating band.

Corrective Actions: When the acceptance criteria are not met, an evaluation is performed and appropriate corrective actions are taken. The evaluation includes determining whether the same condition or situation is applicable to components in the emergency feedwater flow path that are not in the test flow path and what additional actions need to be taken. Corrective actions are performed in accordance with the ANO-1 Corrective Action Program.

Confirmation Process: The ANO-1 Corrective Action Program is implemented to ensure that corrective actions are completed and are effective.

Administrative Controls: Test procedures, test documentation, and corrective actions associated with emergency feedwater pump testing are controlled in accordance with the ANO-1 administrative (document) control program.

Operating Experience: Emergency feedwater system testing challenges the pressure boundary and heat transfer functions for system components. A review of ANO-1 condition report summaries did not identify any occurrence of fouling of the system heat exchangers. The continued implementation of emergency feedwater pump testing provides reasonable assurance that fouling of the system heat exchangers will be detected and corrected so that the emergency feedwater system will continue to perform its intended function consistent with the current licensing basis for the period of extended operation.

As stated in Section 4.21.6 of Appendix B of the ANO-1 LRA, fouling in the system heat exchangers is the primary aging effect that this testing will identify. As shown in Table 3.5-3, the Emergency Feedwater Pump Testing Program is one of several programs used to manage the effects of aging on the emergency feedwater system. For each specific component commodity grouping and aging effect where the Emergency Feedwater Pump Testing Program is credited, at least one other aging management program is credited. For the loss of material and loss of mechanical closure integrity aging effects, these other programs include ASME Section XI ISI-IWC and -IWD Inspections, the Wall Thinning Inspection, and Heat Exchanger Monitoring, which use non-destructive examination methods. Also, these other programs include the Secondary Chemistry Monitoring and the Oil Analysis Program, which assist to minimize fouling.

3.3.5-14 **With respect to the process for identifying aging effects requiring aging management for non-Class 1 components in Appendix C, address the following:**

(a) **Section 1.4 on page C-10 states that for environments with extremely low oxygen content (< 0.1 ppm), crevice corrosion is non-significant. Provide a reference(s) for this threshold value.**

The reference for the statement that crevice corrosion is considered insignificant for environments with extremely low oxygen content (<0.1 ppm) is as follows:

D.J. DePaul, "Corrosion and Wear Handbook for Water-Cooled Reactors," McGraw-Hill, New York, 1957.

(b) **Section 2.3.1 on page C-13 states that the condition for pitting corrosion to occur is the presence of halogens in excess of 150 ppb, oxygen in excess of 100 ppb and stagnant or low flow conditions. However, because of chemical concentration at locations of stagnant or low flow, pitting corrosion could occur at those locations, even if the halogens and oxygen are below these limits.**

The limits for pitting corrosion, which are based on EPRI guidelines for primary and secondary water chemistry, have been used in the nuclear industry and at ANO-1 for many years. Operating experience has shown that they are effective in preventing pitting corrosion.

(c) **Section 3.3.1 on page C-15 states that loss of material due to erosion-corrosion is an applicable aging effect under certain conditions. Describe these conditions for the four steam and power conversion systems considered in the license renewal application.**

Erosion-corrosion is the loss of material owing to the combined actions of erosion of a flowing fluid and corrosion of the newly exposed base metal. The extent of erosion-corrosion is influenced by fluid velocity, environmental characteristics (temperature and fluid chemistry), and material susceptibility. Flow rates less than six feet per second will not cause erosion-corrosion of carbon and low-alloy steels.

Based on this criteria, carbon steel components in the emergency feedwater system and the condensate storage and transfer system will not experience erosion-corrosion under normal conditions since the emergency feedwater system is not normally in service and the water in the condensate storage and transfer system is normally stagnant. Erosion-corrosion of carbon steel components in the main steam and main feedwater systems is an applicable aging mechanism that can cause a loss of material as shown in Tables 3.5-1 and 3.5-2 of the ANO-1 LRA.

(d) Provide a justification as to why the loss of material due to crevice corrosion is not considered for systems having treated water environment (page C-15), raw water environment (page C-16), fuel oil environment (page C-19).

Appendix C of the ANO-1 LRA was intended to provide general information about the aging management review process but not intended to be a comprehensive description of the process. In performing the aging management reviews, loss of material due to crevice corrosion was considered a potential aging effect for treated water and raw water environments. The omission of a discussion in Appendix C of this aging effect for each of these environments was an error. For a treated water environment, loss of material due to crevice corrosion is a potential aging effect for carbon steel, low alloy steel, cast iron, bronze, brass, admiralty, and 90-10 copper-nickel under certain conditions. For a raw water environment, loss of material due to crevice corrosion is an applicable aging effect for carbon steel, low alloy steel, cast iron, stainless steel, bronze, brass, admiralty, and 90-10 copper-nickel under certain conditions.

As noted in Appendix C, Section 6.3.1 (page C-20) of the ANO-1 LRA, loss of material due to crevice corrosion is an applicable aging effect for various metals in a fuel oil environment at locations containing oxygenated water.

(e) Section 6.3.1 on page C-20 states that little water is expected in the fuel oil system and MIC is not a concern for the ANO-1 fuel oil. However, in Section 6.3.2 on the same page, MIC is considered as an applicable aging effect for lubricating oil. Provide a basis as to why water in the fuel oil system and the resulting MIC is not a

potential aging effect at ANO-1. In the past, water intrusion and the resulting MIC has been identified as a potential aging effect requiring an aging management program. An absence of MIC in the plant-specific operating experience has been used to demonstrate the effectiveness of the actions taken to prevent/monitor for water intrusion and to examine for the presence of MIC. Unless ANO-1 fuel oil system is unique in design, loss of material caused by MIC needs to be identified as an aging effect requiring an AMP. Provide a justification for excluding the loss of material due to MIC or identify an AMP(s) to manage this effect of aging.

Appendix C, Section 6.3.1 of the ANO-1 LRA states, "Loss of material due to microbiologically influenced corrosion is an applicable aging effect for brass, carbon steel, copper, and stainless steel materials exposed to fuel oil if microorganisms are present." This section also states, "Due to the addition of biocides, microbiologically influenced corrosion is not a concern for the ANO-1 fuel oil." This addition of biocides is part of the Diesel Fuel Monitoring Program (see Appendix B, Section 4.6.4 of the ANO-1 LRA) that manages the loss of material due to microbiologically influenced corrosion. Table 3.4-7 of the ANO-1 LRA lists this aging management program for fuel oil system components exposed to a fuel oil environment.