# APPENDIX B
# AGING MANAGEMENT PROGRAMS AND ACTIVITIES

## TABLE OF CONTENTS

# B.0 INTRODUCTION

## B.0.1 Overview

The aging management review results for the integrated plant assessment of Arkansas Nuclear One – Unit 2 (ANO-2) are presented in Sections 3.1 through 3.6 of this application. The programs credited in the integrated plant assessment for managing aging effects are described in this appendix.

Each aging management program described in this appendix has ten elements in accordance with the guidance in NUREG-1800 (Reference B.2-1) Appendix A.1, "Aging Management Review - Generic," Table A.1-1, "Elements of an Aging Management Program for License Renewal." For aging management programs that are comparable to the programs described in Sections X and XI of NUREG-1801 (Reference B.2-2), the ten elements have been compared to the elements of the NUREG-1801 program. For plant-specific programs which do not correlate with NUREG-1801, the ten elements are addressed in the program description.

## B.0.2 Format of Presentation

For those aging management programs that are comparable to the programs described in Sections X and XI of NUREG-1801, the program discussion is presented in the following format:

- **Program Description** — presents an abstract of the overall program.
- **NUREG-1801 Consistency** — provides a summary of the degree of consistency between the ANO-2 program and the corresponding NUREG-1801 program, when applicable (i.e., degree of similarity, etc.).
- **Exceptions to the NUREG-1801** — when applicable, this section outlines exceptions to the NUREG-1801 program, including a justification for the exceptions.
- **Enhancements** — when applicable, this section presents future program enhancements with a proposed schedule for their completion. Additional program features to manage aging effects not addressed by the NUREG-1801 program are also described as enhancements.
- **Operating Experience** — this section provides a discussion of operating experience information specific to the program.
- **Conclusion** — this section provides a statement of reasonable assurance that the program is effective, or will be effective, once implemented with necessary enhancements.

For plant-specific programs, the above format is generally followed, with additional discussion of each of the ten elements.

### B.0.3 ANO-2 Corrective Actions, Confirmation Process and Administrative Controls

Three elements common to all aging management programs are corrective actions, confirmation process and administrative controls. Discussion of these elements is presented below. Corrective actions for some programs have program-specific details which are included in the descriptions of individual programs, but further discussion of the confirmation process and administrative controls is not necessary and is not included in the descriptions of individual programs.

**Corrective Actions**

ANO-2 quality assurance (QA) procedures, review and approval processes, and administrative controls are implemented in accordance with the requirements of 10 CFR Part 50, Appendix B. Conditions adverse to quality, such as failures, malfunctions, deviations, defective material and equipment, and nonconformances, are promptly identified and corrected. In the case of significant conditions adverse to quality, measures are implemented to ensure that the cause of the nonconformance is determined and that corrective action is taken to lessen the likelihood of recurrence. In addition, the root cause of the significant condition adverse to quality and the corrective action implemented are documented and reported to appropriate levels of management.

**Confirmation Process**

ANO-2 quality assurance (QA) procedures, review and approval processes, and administrative controls are implemented in accordance with the requirements of 10 CFR Part 50, Appendix B. The corrective action program includes the requirement that measures be taken to lessen the likelihood of recurrence of significant conditions adverse to quality. These measures will include actions to verify effective implementation of proposed corrective actions. Corrective actions for both safety-related and nonsafety-related structures and components are accomplished per the existing corrective action program. The confirmation process is part of the corrective action program and for significant conditions adverse to quality, includes

- reviews to assure that proposed actions are adequate,
- tracking and reporting of open corrective actions, and
- root cause determinations, and reviews of corrective action effectiveness.

Followup inspection required by the confirmation process is documented in accordance with the corrective action program. The corrective action program constitutes the confirmation process for aging management programs and activities. The confirmation process is consistent with NUREG-1801.

**Administrative Controls**

ANO-2 quality assurance (QA) procedures, review and approval processes, and administrative controls are implemented in accordance with the requirements of 10 CFR Part 50, Appendix B. Administrative control for both safety-related and nonsafety-related structures and components is accomplished per the existing document control program in accordance with plant Technical Specifications. Administrative controls are consistent with NUREG-1801.

### B.0.4 Operating Experience

Operating experience for the programs and activities credited with managing the effects of aging was reviewed. Operating experience reviewed included corrective actions resulting in program enhancements.

### B.0.5 Aging Management Programs

The following aging management programs are described in the sections listed of this appendix. The programs are either comparable to programs described in NUREG-1801 or are plant-specific. The correlation between NUREG-1801 programs and ANO-2 programs is shown in Table B-1. Plant-specific programs are listed near the end of Table B-1. Programs are identified as either existing or new.

1) Alloy 600 Aging Management Program [Section B.1.1] [new]
2) Bolting and Torquing Activities [Section B.1.2] [existing]
3) Boric Acid Corrosion Prevention Program [Section B.1.3] [existing]
4) Buried Piping Inspection Program [Section B.1.4] [new]
5) Cast Austenitic Stainless Steel (CASS) Evaluation Program [Section B.1.5] [new]
6) Containment Leak Rate Program [Section B.1.6] [existing]
7) Diesel Fuel Monitoring Program [Section B.1.7] [existing]
8) Environmental Qualification (EQ) of Electric Components Program [Section B.1.8] [existing]
9) Fatigue Monitoring Program [Section B.1.9] [existing]
10) Fire Protection Program [Section B.1.10.1] [existing]
11) Fire Water System Program [Section B.1.10.2] [existing]
12) Flow-Accelerated Corrosion Program [Section B.1.11] [existing]
13) Heat Exchanger Monitoring Program [Section B.1.12] [new]
14) Inservice Inspection - Containment Inservice Inspection (CII) Program [Section B.1.13] [existing]
15) Inservice Inspection - Inservice Inspection (ISI) Program [Section B.1.14] [existing]
16) Non-EQ Inaccessible Medium-Voltage Cable Program [Section B.1.15] [new]

17) Non-EQ Insulated Cables and Connections Program [Section B.1.16] [new]

18) Oil Analysis Program [Section B.1.17] [existing]

19) Periodic Surveillance and Preventive Maintenance Program [Section B.1.18] [existing]

20) Pressurizer Examinations Program [Section B.1.19] [new]

21) Reactor Vessel Head Penetration Program [Section B.1.20] [existing]

22) Reactor Vessel Integrity Program [Section B.1.21] [existing]

23) Reactor Vessel Internal Cast Austenitic Stainless Steel Components Program [Section B.1.22] [new]

24) Reactor Vessel Internals Stainless Steel Plates, Forgings, Welds, and Bolting Program [Section B.1.23] [new]

25) Service Water Integrity Program [Section B.1.24] [existing]

26) Steam Generator Integrity Program [Section B.1.25] [existing]

27) Structures Monitoring - Masonry Wall Program [Section B.1.26] [existing]

28) Structures Monitoring - Structures Monitoring Program [Section B.1.27] [existing]

29) System Walkdown Program [Section B.1.28] [existing]

30) Wall Thinning Monitoring Program [Section B.1.29] [new]

31) Water Chemistry Control - Auxiliary Systems Water Chemistry Control Program [Section B.1.30.1] [existing]

32) Water Chemistry Control - Closed Cooling Water Chemistry Control Program [Section B.1.30.2] [existing]

33) Water Chemistry Control - Primary and Secondary Water Chemistry Control Program [Section B.1.30.3] [existing]

## B.0.6 Correlation with NUREG-1801 Aging Management Programs

The correlation between NUREG-1801 programs and ANO-2 programs is shown below. For the ANO-2 programs, links to appropriate sections of this appendix are provided.

**Table B-1**

| NUREG-1801 Number | NUREG-1801 Program | ANO-2 Program |
|---|---|---|
| XI.M1 | ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD | See plant-specific Inservice Inspection - Inservice Inspection Program [Section B.1.13] |
| XI.M2 | Water Chemistry | Water Chemistry Control - Primary and Secondary Water Chemistry Control Program [Section B.1.30.3] |
| XI.M3 | Reactor Head Closure Studs | See plant-specific Inservice Inspection - Inservice Inspection Program [Section B.1.13] |
| XI.M4 | BWR Vessel ID Attachment Welds | Not Applicable |
| XI.M5 | BWR Feedwater Nozzle | Not Applicable |
| XI.M6 | BWR Control Rod Drive Return Line Nozzle | Not Applicable |
| XI.M7 | BWR Stress Corrosion Cracking | Not Applicable |
| XI.M8 | BWR Penetrations | Not Applicable |
| XI.M9 | BWR Vessel Internals | Not Applicable |
| XI.M10 | Boric Acid Corrosion | Boric Acid Corrosion Prevention Program [Section B.1.3] |
| XI.M11 | Nickel-Alloy Nozzles and Penetrations | Reactor Vessel Head Penetration Program [Section B.1.20] |
| XI.M12 | Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) | Cast Austenitic Stainless Steel (CASS) Evaluation Program [Section B.1.5] |
| XI.M13 | Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS) | Reactor Vessel Internal Cast Austenitic Stainless Steel Components Program [Section B.1.22] |
| XI.M14 | Loose Part Monitoring | Not Applicable |

| Table B-1 (Continued) | | |
|---|---|---|
| **NUREG-1801 Number** | **NUREG-1801 Program** | **ANO-2 Program** |
| XI.M15 | Neutron Noise Monitoring | Not Applicable |
| XI.M16 | PWR Vessel Internals | Reactor Vessel Internals Stainless Steel Plates, Forgings, Welds, and Bolting Program [Section B.1.23] |
| XI.M17 | Flow-Accelerated Corrosion | Flow-Accelerated Corrosion Program [Section B.1.11] |
| XI.M18 | Bolting Integrity | See plant-specific Bolting and Torquing Activities Program [Section B.1.2] |
| XI.M19 | Steam Generator Tube Integrity | Steam Generator Integrity Program [Section B.1.25] |
| XI.M20 | Open-Cycle Cooling Water System | Service Water Integrity Program [Section B.1.24] |
| XI.M21 | Closed-Cycle Cooling Water System | Water Chemistry Control - Closed Cooling Water Chemistry Control Program [Section B.1.30.2] |
| XI.M22 | Boraflex Monitoring | Not Applicable |
| XI.M23 | Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems | See Structures Monitoring Program [Section B.1.27 |
| XI.M24 | Compressed Air Monitoring | Not Applicable |
| XI.M25 | BWR Reactor Water Cleanup System | Not Applicable |
| XI.M26 | Fire Protection | Fire Protection Program [Section B.1.10.1] |
| XI.M27 | Fire Water System | Fire Water System Program [Section B.1.10.2] |
| XI.M28 | Buried Piping and Tanks Surveillance | Buried Piping Inspection Program [Section B.1.4] |
| XI.M29 | Aboveground Carbon Steel Tanks | Not Applicable |

| Table B-1 (Continued) | | |
|---|---|---|
| **NUREG-1801 Number** | **NUREG-1801 Program** | **ANO-2 Program** |
| XI.M30 | Fuel Oil Chemistry | Diesel Fuel Monitoring Program [Section B.1.7] |
| XI.M31 | Reactor Vessel Surveillance | Reactor Vessel Integrity Program [Section B.1.21] |
| XI.M32 | One-Time Inspection | Not Applicable |
| XI.M33 | Selective Leaching of Materials | See the following programs:<br>• Diesel Fuel Monitoring [Section B.1.7]<br>• Fire Water System [Section B.1.10.2]<br>• Oil Analysis [Section B.1.17]<br>• Periodic Surveillance and Preventive Maintenance [Section B.1.18]<br>• Service Water Integrity [Section B.1.24]<br>• System Walkdown [Section B.1.28]<br>• Auxiliary Systems Water Chemistry Control [Section B.1.30.1]<br>• Primary and Secondary Water Chemistry Control [Section B.1.30.3] |
| XI.M34 | Buried Piping and Tanks Inspection | Buried Piping Inspection Program [Section B.1.4] |
| XI.E1 | Electrical Cables and Connections Not Subject to 10CFR50.49 Environmental Qualification Requirements | Non-EQ Insulated Cables and Connections Program [Section B.1.16] |
| XI.E2 | Electrical Cables Not Subject to 10CFR50.49 Environmental Qualification Requirements Used in Instrumentation Circuits | Not Applicable |
| XI.E3 | Inaccessible Medium-Voltage Cables Not Subject to 10CFR50.49 Environmental Qualification Requirements | Non-EQ Inaccessible Medium-Voltage Cable Program [Section B.1.15] |
| XI.S1 | ASME Section XI, Subsection IWE | See plant-specific Inservice Inspection - Containment Inservice Inspection Program [Section B.1.13] |

| Table B-1 (Continued) | | |
|---|---|---|
| **NUREG-1801 Number** | **NUREG-1801 Program** | **ANO-2 Program** |
| XI.S2 | ASME Section XI, Subsection IWL | See plant-specific Inservice Inspection - Containment Inservice Inspection Program [Section B.1.13] |
| XI.S3 | ASME Section XI, Subsection IWF | See plant-specific Inservice Inspection - Inservice Inspection Program [Section B.1.14] |
| XI.S4 | 10 CFR 50, Appendix J | Containment Leak Rate Program [Section B.1.6] |
| XI.S5 | Masonry Wall Program | Structures Monitoring - Masonry Wall Program [Section B.1.26] |
| XI.S6 | Structures Monitoring Program | Structures Monitoring - Structures Monitoring Program [Section B.1.27] |
| XI.S7 | RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants | Not Applicable |
| XI.S8 | Protective Coating Monitoring and Maintenance Program | Not Applicable |
| Chapter X | | |
| X.M1 | Metal Fatigue of Reactor Coolant Pressure Boundary | Fatigue Monitoring Program [Section B.1.9] |
| X.E1 | Environmental Qualification (EQ) of Electric Components | Environmental Qualification (EQ) of Electric Components Program [Section B.1.8] |
| X.S1 | Concrete Containment Tendon Prestress | See plant-specific Inservice Inspection - Containment Inservice Inspection Program [Section B.1.13] |
| Plant-Specific Programs | | |
| NA | Plant-specific program | Alloy 600 Aging Management Program [Section B.1.1] |

| Table B-1 (Continued) | | |
|---|---|---|
| **NUREG-1801 Number** | **NUREG-1801 Program** | **ANO-2 Program** |
| NA | Plant-specific program | Bolting and Torquing Activities [Section B.1.2] |
| NA | Plant-specific program | Heat Exchanger Monitoring Program [Section B.1.12] |
| NA | Plant-specific program | System Walkdown Program [Section B.1.28] |
| NA | Plant-specific program | Inservice Inspection – Containment Inservice Inspection (CII) Program [Section B.1.13] |
| NA | Plant-specific program | Inservice Inspection – Inservice Inspection (ISI) Program [Section B.1.14] |
| NA | Plant-specific program | Oil Analysis Program [Section B.1.17] |
| NA | Plant-specific program | Pressurizer Examinations Program [Section B.1.19] |
| NA | Plant-specific program | Periodic Surveillance and Preventive Maintenance Program [Section B.1.18] |
| NA | Plant-specific program | Wall Thinning Monitoring Program [Section B.1.29] |
| NA | Plant-specific program | Water Chemistry Control - Auxiliary Systems Water Chemistry Control Program [Section B.1.30] |

# B.1 AGING MANAGEMENT PROGRAMS AND ACTIVITIES

## B.1.1 ALLOY 600 AGING MANAGEMENT

**Program Description**

There is no corresponding NUREG-1801 program. The NUREG-1801 Nickel-Alloy Nozzles and Penetrations Program (XI.M11) applies to reactor vessel closure head penetrations.

The Reactor Vessel Head Penetration Program will manage the Alloy 600 reactor vessel head penetrations and the Steam Generator Integrity Program will manage cracking of the Alloy 690 steam generator tubes and plugs for the period of extended operation. Aging effects on the balance of Alloy 600/690 items and Alloy 52/152 and 82/182 welds will be managed by the Alloy 600 Aging Management Program.

The aging effect requiring management for Alloy 600/690 items (SB-167, SB-168, etc.), Alloy 52/152 welds and Alloy 82/182 welds is cracking by primary water stress corrosion cracking (PWSCC).

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

**Evaluation**

### 1. Scope of Program

The following items at ANO-2 are within the scope of this program.

| Component | Item | Description |
|---|---|---|
| RCS piping | Connections between safe ends and nozzles and the RCP safe ends | Welds between the safe ends to the surge, letdown, drain, charging inlet, safety injection, shutdown cooling, and spray nozzles were made by buttering the ferritic nozzles with Alloy 182 weld metal then completing the weld with Alloy 82/182. |
| | Thermal sleeves for surge line, safety injection nozzle, and charging inlet nozzle, RTD nozzles, pressure measurement nozzle, sampling nozzle, and replacement pressure nozzle | These components are fabricated from Alloy 600/690. |

| Component | Item | Description |
|---|---|---|
| Pressurizer | Surge nozzle | Low alloy steel surge nozzle buttered with Alloy 182/182 is connected to CASS safe end. Surge nozzle nickel alloy thermal sleeve is connected to safe end using Alloy 82/182 weld. |
| | Spray nozzle | Alloy 82/182 weld connects low alloy spray nozzle to stainless steel safe end. Spray nozzle nickel alloy thermal sleeve is connected to safe end with Alloy 82/182 weld. |
| | Lower head | Lower head is low alloy steel with Alloy 82/182 cladding. |
| | Pressure measurement, vent, upper level, and temperature nozzles, heater sheath, heater sleeve, and end plugs, heater support plates and heater support plate brackets | Components fabricated from Alloy 600/690. |
| Reactor vessel | Lower shell and bottom head cladding. | Lower shell and bottom head are clad with nickel-based alloy. |
| | Control element drive mechanism (CEDM) motor housing upper and lower end fitting, CEDM upper pressure housing lower fitting, surveillance capsule holders, leakage monitor tubes, core stabilizing lugs, core stop lugs, and the flow skirt | Components fabricated from nickel-based alloy (i.e., Alloy 600/690). |
| Steam generator | Tube plate | Primary side of tube plate is clad with Alloy 82/182. |
| | Channel head divider plate and primary nozzle closure rings | Components fabricated from Alloy 600/690. |

**2. Preventive Actions**

No actions are taken as part of this program to prevent aging effects or mitigate aging degradation.

**3. Parameters Monitored/Inspected**

The Alloy 600 Aging Management Program detects degradation by using the examination and inspection requirements of ASME Section XI. The parameters monitored will be the presence and extent of cracking.

**4. Detection of Aging Effects**

This program will detect cracking by PWSCC prior to loss of component intended function. A number of Alloy 600, Alloy 52/152 and Alloy 82/182 locations receive examination in accordance with ASME Section XI. Items receiving volumetric, surface, or visual examination are listed below.

Pressurizer surge and spray nozzle-to-safe end dissimilar metal welds receive volumetric examination in accordance with ASME Section XI, Examination Category B-F. The measurement, vent, upper level, and temperature nozzles, and heater sheath, heater sleeve, and end plug received visual examination (VT-2) from the exterior of the vessel in accordance with ASME Section XI, Examination Category B-P.

RCS surge, letdown, drain, charging inlet, safety injection, shutdown cooling, and spray nozzles-to-safe end dissimilar metal welds receive volumetric examination in accordance with ASME Section XI, Examination Category B-F. The RTD nozzles, pressure measurement nozzle, sampling nozzle, and replacement pressure nozzle receive either a surface (< NPS 4") or a surface and volumetric examination (≥ NPS 4") under Examination Category B-J.

The control element drive mechanism (CEDM) motor housing upper and lower end fitting, and CEDM upper pressure housing lower fitting receive visual examination (VT-2) from the exterior in accordance with ASME Section XI, Examination Category B-P.

The surveillance capsule holder receives a visual examination (VT-1) in accordance with ASME Section XI, Examination Category B-N-2. In addition, the flow skirt, core stabilizing and stop lugs receive a visual examination (VT-3) in accordance with B-N-2.

In addition to the ASME Section XI examinations mentioned above, the pressurizer heater and small bore penetrations are visually inspected.

The Alloy 600 and Alloy 82/182 items that are not inspected volumetrically or visually are bounded by the items that receive examinations in accordance with ASME Section XI or otherwise, as described above.

The EPRI Materials Reliability Program (MRP) in conjunction with the PWR owners groups is developing a strategic plan to manage PWSCC of nickel based alloy components. Guidance developed by the MRP and the owners groups will be used to identify critical locations for inspection and augmentation of existing ISI inspections at ANO-2 where appropriate.

**5. Monitoring and Trending**

Records of the inspection program, examination and test procedures, examination/test data, and corrective actions taken are maintained in accordance with the requirements of ASME Section XI, Subsection IWA.

**6. Acceptance Criteria**

The acceptance standards for components that receive examination in accordance with ASME Section XI are in accordance with the appropriate section of IWB-3500. The acceptance criteria for visual inspections require that cognizant members of the system engineering, quality control and design engineering departments review the inspection results for indication of leakage. If abnormalities are identified, a condition report is issued.

**7. Corrective Actions**

For components that do not meet the acceptance criteria, a condition report will be issued in accordance with the Corrective Action Program. This condition report will be used to initiate and track appropriate corrective actions.

**8. Confirmation Process**

This attribute is discussed in Section B.0.3.

**9. Administrative Controls**

This attribute is discussed in Section B.0.3.

**10. Operating Experience**

The Alloy 600 Aging Management Program is a new program for which there is no specific operating experience. The program incorporates proven monitoring techniques and acceptance criteria.

**Conclusion**

The Alloy 600 Aging Management Program will manage the effects of aging on Alloy 600/690 items and Alloy 52/152 and 82/182 welds during the period of extended operation. It incorporates proven monitoring techniques, acceptance criteria, corrective actions, and administrative controls. The program will be initiated prior to the period of extended operation. The Alloy 600 Aging Management Program will provide reasonable assurance that the effects of aging will be managed such that the applicable components will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

## B.1.2 BOLTING AND TORQUING ACTIVITIES

**Program Description**

The Bolting and Torquing Activities Program at ANO-2 is a plant-specific program. A similar program based on EPRI NP-5067 and EPRI TR-104213 has previously been evaluated and approved by the NRC as documented in NUREG-1743, Safety Evaluation Report Related to the License Renewal of Arkansas Nuclear One, Unit 1.

This program relies on recommendations for a comprehensive bolting integrity program, as delineated in the Electric Power Research Institute EPRI NP-5067, Good Bolting Practices. This program also relies on industry recommendations for comprehensive bolting maintenance, as delineated in EPRI TR-104213, Bolted Joint Maintenance & Applications Guide, for pressure retaining bolting.

**Evaluation**

1. **Scope of Program**

   The program covers bolting in high temperature systems and in applications subject to significant vibration as determined during aging management reviews.

2. **Preventive Actions**

   Preventive actions include proper selection of bolting material and the use of the appropriate lubricants and sealants in accordance with the guidelines of EPRI NP-5067.

   Initial inspection of bolting for pressure retaining components includes a check of the bolt torque and uniformity of the gasket compression after assembly. Hot torque checks are not applied to all bolted closures within the scope of this program, but are procedurally controlled if vendor-recommended or if determined necessary on a case-by-case basis.

3. **Parameters Monitored/Inspected**

   Torque values are monitored when the bolted closure is assembled. Maintenance personnel visually inspect components used in the bolted closures to assess their general condition during maintenance.

4. **Detection of Aging Effects**

   The program is a preventive program. Preventive actions under the program prevent loss of mechanical closure integrity.

**5. Monitoring and Trending**

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

**6. Acceptance Criteria**

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

**7. Corrective Actions**

Corrective actions are in conformance with recommendations of EPRI NP-5067 and EPRI TR-104213. The ANO Corrective Action Program is also applicable.

**8. Confirmation Process**

This attribute is discussed in Section B.0.3.

**9. Administrative Controls**

This attribute is discussed in Section B.0.3.

**10. Operating Experience**

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

Repetitive occurrences of deficient bolting and torquing activities are identified by the ANO staff. Corrective actions are established to address deficient conditions regarding torquing of mechanical fasteners and to preclude their recurrence.

This operating experience demonstrates that the Bolting and Torquing Activities Program will provide reasonable assurance that the aging effects associated with bolted closures will be managed such that applicable structures and components will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

**Conclusion**

The Bolting and Torquing Activities Program provides reasonable assurance that the aging effects associated with bolted closures will be managed such that applicable components will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

## B.1.3 BORIC ACID CORROSION PREVENTION

**Program Description**

The Boric Acid Corrosion Prevention Program at ANO-2 is comparable to the program described in NUREG-1801, Section XI.M10, Boric Acid Corrosion.

The program relies on implementation of recommendations of NRC Generic Letter (GL) 88-05 to monitor the condition of the reactor coolant pressure boundary for borated water leakage. Periodic visual inspection of adjacent structures, components, and supports for evidence of leakage and corrosion is an element of the NRC GL 88-05 monitoring program.

**NUREG-1801 Consistency**

With program enhancement, the Boric Acid Corrosion Prevention Program will be consistent with NUREG-1801, Section XI.M10, Boric Acid Corrosion.

**Enhancements**

The following enhancement to the Boric Acid Corrosion Prevention Program will be initiated prior to the period of extended operation.

| Element Affected | Enhancement |
|---|---|
| 1. Scope | The program scope will be revised to include identification and evaluation of the effects of borated water leakage on electrical components in addition to ferritic steel. |
| 6. Acceptance Criteria | The program acceptance criteria will be revised to address electrical components in addition to ferritic steel. |

**Operating Experience**

Recent industry events regarding reactor vessel head degradation required assessments at each site to ensure boric acid corrosion prevention programs are adequate and functioning effectively. A self assessment was performed in February 2003. No significant findings were identified during this assessment.

ANO-1 boric acid corrosion prevention program was reviewed during NRC review of the ANO-1 LRA. The NRC inspection team found that the program should be effective to manage the aging effects due to boric acid corrosion of susceptible materials during the period of extended operation. The governing procedures for the Boric Acid Corrosion Prevention Program apply to ANO-1 and ANO-2.

ANO-2 Licensee Event Report (LER) 50-368/2002-001-00 documents leakage through the reactor coolant system pressure boundary. Five pressurizer heater sleeves were leaking. This LER provides evidence of the effectiveness of the Boric Acid Corrosion Prevention Program. Early detection of leakage precluded boric acid wastage of affected components and adjacent structures and components.

**Conclusion**

The Boric Acid Corrosion Prevention Program has been effective at managing aging effects. With enhancement, the Boric Acid Corrosion Prevention Program will provide reasonable assurance that the effects of aging will be managed such that the applicable components will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

## B.1.4 BURIED PIPING INSPECTION

**Program Description**

The Buried Piping Inspection Program is a new program that will be initiated prior to the period of extended operation. The program will be comparable to the program described in NUREG-1801, Section XI.M34, Buried Piping and Tanks Inspection.

The Buried Piping Inspection Program will include (a) preventive measures to mitigate corrosion and (b) inspections to manage the effects of corrosion on the pressure-retaining capability of buried carbon steel components. Preventive measures will be in accordance with standard industry practice for maintaining external coatings and wrappings. Buried components will be inspected when excavated during maintenance.

**NUREG-1801 Consistency**

The Buried Piping Inspection Program is a new program that will be consistent with, but include exceptions to, NUREG-1801, Section XI.M34, Buried Piping and Tanks Inspection.

**Exceptions to NUREG-1801**

The Buried Piping Inspection Program at ANO-2 will include the following exceptions to the program described in NUREG-1801, Section XI.M34, Buried Piping and Tanks Inspection.

| Element Affected | Exception |
|---|---|
| 1. Scope | NUREG-1801 only refers to buried carbon steel piping and tanks. The ANO-2 program will inspect other buried components, such as valves and bolting, but not tanks. (Note 1) |
| 4. Detection of Aging Effects | NUREG-1801 refers to periodic inspections implying a scheduled frequency. The ANO-2 program will require inspections of buried components only when excavated during maintenance activities. (Note 2) |

1) The additional components are the same material, exposed to the same environment and are expected to have the same aging effects. Thus, the effects of aging will be identified prior to loss of intended function regardless of component type. There are no buried tanks subject to aging management review.

2) The ANO-2 program will entail inspections of the buried components only when excavated during maintenance activities since excavating such components solely to perform inspections poses undue risk of damage to protective coatings. ANO-2 operating experience shows that the frequency of excavating buried components for maintenance activities is sufficient to provide reasonable assurance that the effects of aging will be identified prior to loss of intended

function. Multiple excavations of similar underground piping have been conducted in recent years.

**Operating Experience**

The Buried Piping Inspection Program at ANO-2 is a new program for which there is no operating experience.

**Conclusion**

The Buried Piping Inspection Program will provide reasonable assurance that the effects of aging will be managed such that the applicable components will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation. The program will be initiated prior to the period of extended operation.

## B.1.5 CAST AUSTENITIC STAINLESS STEEL EVALUATION

**Program Description**

The Cast Austenitic Stainless Steel (CASS) Evaluation Program at ANO-2 will be comparable to the program described in NUREG-1801, Section XI.M12, Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS).

Reactor coolant system components will be inspected in accordance with the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI. The ASME Section XI inspection will be augmented to detect the effects of loss of fracture toughness due to thermal aging embrittlement of CASS components. This CASS Evaluation Program will include a determination of the susceptibility of the CASS components to thermal aging embrittlement based on casting method, molybdenum content, and percent ferrite. The applicable ANO-2 components will include the pressurizer surge line piping and elbows, surge nozzle safe end, safety injection and shutdown cooling outlet nozzle safe ends and reactor coolant pump (RCP) safe ends. For potentially susceptible components, as defined below, aging effects will be managed utilizing additional inspections and a component-specific flaw tolerance evaluation. Additional inspections or evaluations will not be required for components that are determined not to be susceptible to thermal aging embrittlement.

This program will not include reactor vessel internals CASS components as these are evaluated and inspected as part of the Reactor Vessel Internals Inspection Program. In addition, screening for susceptibility to thermal aging embrittlement will not be required for pump casings and valve bodies. The existing ASME Section XI inspection requirements, including the alternative requirements of ASME Code Case N-481 for pump casings, are adequate for pump casings and valve bodies.

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

**NUREG-1801 Consistency**

The CASS Evaluation Program will be consistent with NUREG-1801, Section XI.M12, Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS).

**Operating Experience**

The CASS Evaluation Program is a new program for which there is no operating experience.

Based on relevant industry operating experience, this program will provide reasonable assurance that the aging effects will be managed so that the applicable components will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

**Conclusion**

The Cast Austenitic Stainless Steel (CASS) Evaluation Program will provide reasonable assurance that the effects of aging will be managed such that applicable components will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation. The program will be initiated prior to the period of extended operation.

## B.1.6 CONTAINMENT LEAK RATE

**Program Description**

The Containment Leak Rate Program at ANO-2 is comparable to the program described in NUREG-1801, Section XI.S4, 10 CFR 50, Appendix J.

As described in 10 CFR Part 50, Appendix J, containment leak rate tests are required to assure that (a) leakage through primary reactor containment and systems and components penetrating primary containment shall not exceed allowable values specified in the technical specifications or associated bases and (b) periodic surveillance of reactor containment penetrations and isolation valves is performed so that proper maintenance and repairs are made during the service life of containment, and systems and components penetrating primary containment.

**NUREG-1801 Consistency**

The Containment Leak Rate Program is consistent with the program described in NUREG-1801, Section XI.S4, 10 CFR Part 50, Appendix J.

**Operating Experience**

The last integrated leak rate test (ILRT) was performed during 2R14. ILRT leakage data and the overall primary containment local leak rate test (LLRT) for recent outages indicates no significant degradation of the containment structure or penetrations. In June 2002, a self-assessment of the program was performed. The comprehensive self-assessment confirmed compliance with regulatory criteria. This operating experience confirms that this aging management program will be effective at detecting unacceptable leakage of the ANO-2 containment.

**Conclusion**

The Containment Leak Rate Program has been effective at managing aging effects. The Containment Leak Rate Program provides reasonable assurance that the effects of aging will be managed such that the applicable components will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

## B.1.7 DIESEL FUEL MONITORING

**Program Description**

The Diesel Fuel Monitoring Program at ANO-2 is comparable to the program described in NUREG-1801, Section XI.M30, Fuel Oil Chemistry Program.

The purpose of the Diesel Fuel Monitoring Program is to ensure that adequate diesel fuel quality is maintained to prevent plugging of filters, fouling of injectors, and corrosion of the fuel systems.

**NUREG-1801 Consistency**

The Diesel Fuel Monitoring Program is consistent with, but includes exceptions to, NUREG-1801, Section XI.M30, Fuel Oil Chemistry Program.

**Exceptions to NUREG-1801**

The Diesel Fuel Monitoring Program includes the following exceptions to the program described in NUREG-1801, Section XI.M30, Fuel Oil Chemistry Program.

| Element Affected | Exception |
|---|---|
| 2. Preventive Actions | No additives are used (other than biocide) beyond what the refiner adds during production. (Note 1) |
| 3. Parameters Monitored / Inspected | Only ASTM Standard D1796 is used for determination of water and sediment, rather than Standards D1796 and D2709. (Note 2) |
| | The ANO-2 program specifies the method of ASTM D2276 with a 0.8 μm filter, instead of the modified ASTM D2276, Method A, with a 3.0 μm filter. (Note 3) |
| 4. Detection of Aging Effects | The program does not include ultrasonic measurements of tank bottoms. (Note 4) |
| 6. Acceptance Criteria | Only ASTM Standard D1796 is used for determination of water and sediment, rather than Standards D1796 and D2709. (Note 2) |
| | The ANO-2 program specifies the method of ASTM D2276 with a 0.8 μm filter, instead of the modified ASTM D2276, Method A, with a 3.0 μm filter. (Note 3) |

1) The #2 diesel fuel used at ANO-2 contains a comprehensive additive package.

2) NUREG-1801 states that ASTM Standards D1796 and D2709 are used for determination of water and sediment. However, these standards describe the determination of water and sediment for oils with different viscosities. Therefore, only Standard D1796 applies to ANO diesel fuel. This applies to Parameters Monitored/Inspected and to Acceptance Criteria.

3) ANO-2 conducts particulate analysis using a 0.8 micron filter, rather than the 3.0 micron filter specified in NUREG-1801. Use of a filter with a smaller pore size results in a larger sample of particulates since smaller particles are retained. Thus, use of a 0.8 micron filter is more conservative than use of the 3.0 micron filter specified in NUREG-1801.

4) Compliance with diesel fuel oil standards and periodic sampling provides assurance that fuel oil contaminants that cause degradation are below appropriate limits. Internal surfaces of tanks that are drained for cleaning are visually inspected for degradation.

## Operating Experience

ANO-2 experienced fuel oil related problems in 1986 (LER 50-368/86-014-01) and 1992 (LER 50-368/92-004-00). Significant program improvements were implemented as a result of these events. The review of recent operating experience did not identify unacceptable levels of water, particulate contamination, or biological fouling in the fuel oil. A review of condition reports did not identify instances of fuel oil system component failures attributed to the condition of the fuel oil.

Condition report trending data did not identify a need for improvements to this program. Quarterly assessments are performed to review diesel fuel quality parameters to ensure acceptance criteria are being met and to identify early indications of problems.

## Conclusion

The Diesel Fuel Monitoring Program has been effective at managing aging effects. The program has been improved through evaluation of site and industry operating experience. The Diesel Fuel Monitoring Program provides reasonable assurance that the aging effects will be managed such that the applicable components will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

## B.1.8 ENVIRONMENTAL QUALIFICATION OF ELECTRIC COMPONENTS

### Program Description

The Environmental Qualification (EQ) of Electric Components Program for electric components at ANO-2 is comparable to the program described in NUREG-1801, Section X.E1, Environmental Qualification (EQ) of Electric Components.

The Nuclear Regulatory Commission (NRC) has established nuclear station environmental qualification (EQ) requirements in 10CFR50.49. 10CFR50.49 specifically requires that an EQ program be established to demonstrate that certain electrical components located in harsh plant environments (that is, those areas of the plant that could be subject to the harsh environmental effects of a loss of coolant accident (LOCA), high energy line breaks (HELBs) or post-LOCA radiation) are qualified to perform their safety function in those harsh environments after the effects of inservice aging. 10CFR50.49 requires that the effects of significant aging mechanisms be addressed as part of environmental qualification.

The ANO-2 EQ program manages component thermal, radiation, and cyclical aging through the use of aging evaluations based on 10CFR50.49(f) qualification methods. As required by 10CFR50.49, EQ components not qualified for the current license term are to be refurbished, replaced, or have their qualification extended prior to reaching the aging limits established in the evaluation. Aging evaluations for EQ components are considered time-limited aging analyses (TLAAs) for license renewal.

### NUREG-1801 Consistency

The Environmental Qualification (EQ) of Electric Components Program is consistent with the program described in NUREG-1801, Section X.E1, Environmental Qualification (EQ) of Electric Components.

### Operating Experience

Processes are in place to ensure 10CFR Part 21 and vendor notifications are appropriately resolved, deficiencies identified during routine maintenance are tracked to closure, components are upgraded and replaced when required, and EQ component documentation is revised when necessary. A review of condition reports revealed several conditions related to the performance of EQ components; however, condition report trending data did not identify negative trends or a need for improvements to this program.

EPRI performed an assessment of the ANO EQ Program in March, 2001. EQ Program organization, procedures, documentation, operating experience, configuration management, and procurement practices were reviewed. A peer review with team members from other sites was completed in August 2002. Both assessments concluded that the ANO EQ program is strong and well managed.

Review of operating experience applicable to this program confirms that deviating conditions are documented and resolved through the Corrective Action Program.

**Conclusion**

The Environmental Qualification (EQ) of Electric Components Program is consistent with the program described in NUREG-1801, Section X.E1, Environmental Qualification (EQ) of Electric Components. The overall effectiveness of the Environmental Qualification (EQ) of Electric Components Program is demonstrated by the excellent operating experience for systems, structures, and components in the program. The program has been subject to periodic internal and external assessments that facilitate continuous improvement. The Environmental Qualification (EQ) of Electric Components Program provides reasonable assurance that the effects of aging will be managed such that the applicable components will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

## B.1.9 FATIGUE MONITORING

**Program Description**

The Fatigue Monitoring Program at ANO-2 is comparable to the program described in NUREG-1801, Section X.M1, Metal Fatigue of Reactor Coolant Pressure Boundary.

In order not to exceed the design limit on fatigue usage, the Fatigue Monitoring Program tracks the number of critical thermal and pressure transients for selected reactor coolant system (RCS) components. The program ensures the validity of analyses that explicitly assumed a specified number of thermal and pressure fatigue transients. The effects of reactor coolant environment on fatigue analyses are discussed in Section 4.3 of the application, which is consistent with the treatment of environmentally-assisted fatigue for ANO-1 license renewal.

**NUREG-1801 Consistency**

The Fatigue Monitoring Program will be consistent with, but include exceptions to, the program described in NUREG-1801, Section X.M1, Metal Fatigue of Reactor Coolant Pressure Boundary.

**Exceptions to NUREG-1801**

The Fatigue Monitoring Program at ANO-2 will be consistent with the program described in NUREG-1801, Section X.M1, Metal Fatigue of Reactor Coolant Pressure Boundary, with the following exception.

| Attributes Affected | Exceptions |
|---|---|
| 2. Preventive Actions | The Fatigue Monitoring Program only involves tracking the number of transient cycles. (Note 2) |
| 4. Detection of Aging Effects | The ANO-2 program does not provide for periodic update of the fatigue usage calculations. Corrective actions are initiated only when the number of accumulated cycles approach the number of component design cycles. (Note 1) |

1) Updates of fatigue usage calculations are not necessary unless the number of accumulated fatigue cycles approaches the number of assumed design cycles.

2) The effect of the reactor water environment on fatigue is addressed as described in Section 4.3.3.1 of the application.

**Operating Experience**

ANO-2 issues quarterly reports documenting operating history, the total number of critical types of transients, and the design limits. Condition report trending data does not reveal need for improvements to this program.

The number of pressure and temperature transient cycles is monitored and periodically compared with the design cycle count, as required by the Fatigue Monitoring Program, to ensure that fatigue sensitive components don't exceed their allowable number of design cycles. This operating experience provides reasonable assurance that the Fatigue Monitoring Program will be effective in managing the effects of aging so that components crediting this program can perform their intended function consistent with the current licensing basis during the period of extended operation.

**Conclusion**

The Fatigue Monitoring Program has been demonstrated to maintain the validity of the fatigue design basis for reactor coolant system components designed to withstand the effects of cyclic loads due to reactor system temperature and pressure changes.

The Fatigue Monitoring Program provides reasonable assurance that the effects of aging will be managed such that the applicable components continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

## B.1.10 FIRE PROTECTION

The Fire Protection Program encompasses two programs, Fire Protection and Fire Water.

### B.1.10.1 Fire Protection

**Program Description**

The Fire Protection Program at ANO-2 is comparable to the program described in NUREG-1801, Section XI.M26, Fire Protection.

The fire protection program includes a fire barrier inspection and a diesel-driven fire pump inspection. The fire barrier inspection requires periodic visual inspection of fire barrier penetration seals, fire barrier walls, ceilings, and floors, and periodic visual inspection and functional tests of fire rated doors to ensure that their operability is maintained. The diesel-driven fire pump inspection requires that the pump be periodically tested to ensure that the fuel supply line can perform the intended function.

**NUREG-1801 Consistency**

The Fire Protection Program will be consistent with, but include exceptions to, NUREG-1801, Section XI.M26, Fire Protection.

**Exceptions to NUREG-1801**

The Fire Protection Program at ANO-2 is consistent with the program described in NUREG-1801, Section XI.M26, Fire Protection with the following exceptions.

| Attributes Affected | Exceptions |
|---|---|
| 3. Parameters Monitored/Inspected | Fire doors are inspected and clearances checked annually, not bimonthly. (Note 1) |
| | Function tests of fire doors are performed annually, not daily, weekly or monthly. (Note 1) |
| 1. Scope<br>3. Parameters Monitored/Inspected<br>4. Detection of Aging Effects<br>5. Monitoring and Trending<br>6. Acceptance Criteria | This program is not necessary to manage aging effects on halon fire protection system components. (Note 2) |

(1) The NUREG-1801 program entails testing and inspections at various frequencies. In some instances the ANO-2 program performs tests and inspections on different frequencies. Since aging effects are typically manifest over several years, the change in inspection and testing frequency is insignificant.

(2) The aging management review concluded that the Fire Protection Program is not required to manage the effects of aging for the halon fire protection system components.

## Operating Experience

Condition report reviews indicate that this program has experienced minor discrepancies regarding specific fire barrier components, e.g., penetration seals, fire doors, and structural steel fireproofing. Revised design methods for sealing penetrations resolved the negative trend data and specific conditions. This operating experience illustrates the use of visual inspections to detect degradation of fire barriers prior to loss of intended function.

Recent quality assurance audits of the Fire Protection Program determined the program effectively implements regulatory requirements. Supplemental assessments confirmed the site staff implemented recommended improvements.

## Conclusion

The Fire Protection Program provides reasonable assurance that the effects of aging will be managed such that the applicable components will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

## B.1.10.2 Fire Water System

### Program Description

The Fire Water System Program at ANO-2 is comparable to the program described in NUREG-1801, Section XI.M27, Fire Water System.

This aging management program applies to water-based fire protection systems that consist of sprinklers, nozzles, fittings, valves, hydrants, hose stations, standpipes, and aboveground and underground piping and components that are tested in accordance with the applicable National Fire Protection Association (NFPA) codes and standards. Such testing assures the minimum functionality of the systems. Also, these systems are normally maintained at required operating pressure and monitored such that leakage resulting in loss of system pressure is immediately detected and corrective actions initiated.

In addition, a sample of sprinkler heads will be inspected using the guidance of NFPA 25. The NFPA states that “where sprinklers have been in place for 50 years, they shall be replaced or representative samples from one or more sample areas shall be submitted to a recognized testing laboratory for field service testing.” It also contains guidance to perform this sampling every 10 years after the initial field service testing.

### NUREG-1801 Consistency

With enhancement, the Fire Water System Program will be consistent with, but include an exception to, NUREG-1801, Section XI.M27, Fire Water System.

### Exceptions to NUREG-1801

The program attributes of the Fire Water System Program at ANO-2 will be consistent with the program attributes described in NUREG-1801, Section XI.M27, Fire Water System, with the following exception.

| Attributes Affected | Exception |
|---|---|
| 3. Parameters Monitored/Inspected | ANO-2 does not implement NRC GL 89-13 commitments in the fire water program. (Note 1) |

(1) Every fire main segment (excluding individual system supplies) is verified to be clear of obstruction by a full flow test at least once every 3 years.

## Enhancements

The following enhancement will be initiated prior to the period of extended operation.

| Attributes Affected | Enhancement |
|---|---|
| 1. Scope<br>4. Detection of Aging Effects | A sample of sprinkler heads will be inspected using the guidance of NFPA 25. The NFPA also contains guidance to repeat this sampling every 10 years after the initial field service testing. |

## Operating Experience

Condition report trending data did not identify a need for improvements to this program. Industry operating experience regarding the opening of “wet” fire protection systems showed that opening systems results in oxygenation of the water leading to increased corrosion of the pipe. Therefore, quarterly test requirements have been revised to not open system piping for periodic inspections. This is an example of use of industry operating experience to improve the program.

## Conclusion

The Fire Water System Program has been demonstrated capable of managing the aging effects on fire protection components. With enhancements, the Fire Water System Program will provide reasonable assurance that the effects of aging will be managed such that the applicable components will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

### B.1.11 FLOW-ACCELERATED CORROSION

**Program Description**

The Flow-Accelerated Corrosion (FAC) Program at ANO-2 is comparable to the program described in NUREG-1801, Section XI.M17, Flow-Accelerated Corrosion.

This program includes (a) an analysis to determine critical locations, (b) limited initial operational inspections to determine the extent of thinning at these locations, and (c) follow-up inspections to confirm the predictions, or repair or replace components as necessary.

**NUREG-1801 Consistency**

The Flow-Accelerated Corrosion (FAC) Program is consistent with NUREG-1801, Section XI.M17, Flow-Accelerated Corrosion.

**Operating Experience**

Piping sections affected by flow-accelerated corrosion have been replaced with piping materials more resistant to flow-accelerated corrosion. New locations have been included in the program based on both industry and plant-specific operating experience. Trending data did not identify need for improvements to this program.

A Flow-Accelerated Corrosion Program assessment in 2001 determined that program activities were being performed in accordance with applicable industry standards, NRC guidelines, EPRI recommendations and site program requirements. The assessment revealed no significant program deficiencies.

**Conclusion**

The Flow-Accelerated Corrosion Program has been effective at managing aging effects. The program has been improved through evaluation of operating experience. The Flow-Accelerated Corrosion Program provides reasonable assurance that the effects of aging will be managed such that the applicable components will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

## B.1.12 HEAT EXCHANGER MONITORING

**Program Description**

There is no corresponding NUREG-1801 program. This is a plant-specific program.

The Heat Exchanger Monitoring Program will inspect heat exchangers for degradation. If degradation is found, then an evaluation will be performed to evaluate its effects on the heat exchanger's design functions including seismic operability.

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

**Evaluation**

1. **Scope of Program**

   The Heat Exchanger Monitoring Program will manage aging effects on selected heat exchangers as identified in Section 3 of the application.

2. **Preventive Actions**

   This is an inspection program and no actions are taken as part of this program to prevent degradation.

3. **Parameters Monitored/Inspected**

   Non-destructive examinations, such as eddy-current inspections and visual inspections, will be performed. Eddy current inspections may be performed on shell-and-tube heat exchangers where practical. The eddy current inspections of shell-and-tube heat exchangers will consist of a sample inspection of the heat exchanger tubes to identify wall thinning and crack indications. Visual inspections will be performed on the heat exchanger heads, covers and tube sheets where accessible.

4. **Detection of Aging Effects**

   The aging effects being managed by this program for the tubes are loss of material and cracking. The eddy current inspection of the tubes will be every ten years or more frequently if inspection results indicate a need for more frequent inspections. The visual inspections of the accessible heat exchangers will be performed on the same frequency as the eddy current inspections.

   An appropriate sample population of heat exchangers will be determined based on operating experience prior to the inspections. The extent and schedule of the inspections prescribed by the program are designed to maintain seismic qualification and ensure that aging effects will be discovered and repaired before the loss of intended function of the heat exchangers. Inspection can reveal cracking and loss of material that could result in degradation in the seismic qualification of the heat exchangers. Fouling is not addressed by this program.

**5. Monitoring and Trending**

Results will be evaluated against established acceptance criteria and an assessment will be made regarding the applicable degradation mechanism, degradation growth rate and the allowable degradation level. This information will be used to develop future inspection scope and inspection frequency.

**6. Acceptance Criteria**

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

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

**7. Corrective Actions**

This program will be administered under the site QA program which meets the requirements of 10 CFR Part 50, Appendix B.

**8. Confirmation Process**

This attribute is discussed in Section B.0.3.

**9. Administrative Controls**

This attribute is discussed in Section B.0.3.

**10. Operating Experience**

The Heat Exchanger Monitoring Program at ANO-2 is a new program for which there is no operating experience.

**Conclusion**

Eddy current inspections and heat exchanger internal visual inspections are standard industry methods to manage aging effects in heat exchangers. A similar program for ANO-1 has previously been evaluated and approved by the NRC as documented in NUREG-1743, Safety Evaluation Report Related to the License Renewal of Arkansas Nuclear One, Unit 1.

The Heat Exchanger Monitoring Program will be effective for managing aging effects since it will incorporate proven monitoring techniques and conservative acceptance criteria. The Heat Exchanger Monitoring Program will provide reasonable assurance that the effects of aging will be managed such that the applicable components will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation. The program will be initiated prior to the period of extended operation.

## B.1.13 INSERVICE INSPECTION - CONTAINMENT INSERVICE INSPECTION

### Program Description

The ANO-2 Containment Inservice Inspection (CII) Program is a plant-specific program encompassing ASME Section XI Subsection IWE and IWL requirements. The program implements the applicable requirements of ASME Section XI, Subsections IWE and IWL as modified by 10CFR50.55a. Every 10 years the program is updated to the latest ASME Section XI code edition and addendum approved by the Nuclear Regulatory Commission in 10CFR50.55a. A similar program for ANO-1 has previously been evaluated and approved by the NRC as documented in NUREG-1743 (Reference B.2-3).

### Evaluation

1. **Scope of Program**

   The Containment Inservice Inspection Program, under ASME Section XI Subsection IWE, manages loss of material for the steel containment liner and its integral attachments.

   The Containment Inservice Inspection Program, under ASME Section XI Subsection IWL provides confirmation that the effects of aging on the reinforced concrete containment shell and post-tensioning systems will not prevent the performance of intended functions consistent with the current licensing basis for the period of extended operation.

2. **Preventive Actions**

   The Containment Inservice Inspection Program is a monitoring program that does not include preventive actions.

3. **Parameters Monitored/Inspected**

   Visual inspections for IWE monitor for corrosion and loss of material of the steel containment liner and its attachments by inspecting the surface for evidence of flaking, blistering, peeling, discoloration, and other signs of distress.

   For IWL, prestressing force is measured by lift-off testing or equivalent test. In addition, tendon surveillance testing consists of inspection of the sheathing filler material and anchorage, tendon wire continuity testing, and tendon wire inspection.

4. **Detection of Aging Effects**

   The Containment Inservice Inspection Program, under ASME Section XI Subsection IWE, manages loss of material for the steel containment liner and its integral attachments. The program, under ASME Section XI Subsection IWL, manages the effects of aging on the reinforced concrete containment shell and post-tensioning system.

The primary inspection method for the steel containment liner and its integral attachments is visual examination (general visual, VT-3, VT-1). Limited volumetric examination (ultrasonic thickness measurement) and surface examination (e.g., liquid penetrant) may be necessary in some instances.

The primary inspection method for the concrete containment shell is visual examination (general, VT-1). The tendon prestessing force is measured by lift-off or equivalent test. Tendon surveillance testing consists of the sheathing filler material and anchorage inspection, tendon lift-off force measurement, tendon wire continuity testing, tendon wire inspection and tensile testing. The tendon surveillance is performed periodically on a randomly selected group of surveillance tendons to provide confidence in the functional capability of the system.

**5. Monitoring and Trending**

The responsible engineer periodically trends the measured prestressing forces from surveillances. If this review indicates a trend that would result in the tendon forces for a tendon or a group of tendons to be less than the minimum prestess value before the next inspection period, the responsible engineer (or designee) prepares a condition report.

**6. Acceptance Criteria**

The numerical acceptance standards provided in IWE-3000 for wall thickness and the numerical values provided for post-tensioning systems in IWL-3000 are utilized. No other numerical acceptance standards are provided for the steel containment liner and its integral attachments or for the reinforced concrete containment. The expertise and engineering judgment of the responsible engineer are relied upon to detect conditions which could affect the leak tightness or structural integrity of the containment or prevent an inspected component from performing its intended function.

**7. Corrective Actions**

If the numerical acceptance criteria are not met, or the responsible engineer determines that the leak tightness or structural integrity of containment could be compromised by the indicated condition, a condition report is written in accordance with the Corrective Action Program. This condition report is used to initiate and track corrective actions associated with the inspection. Corrective actions will include completion of an engineering evaluation report if required by IWL-2200.

**8. Confirmation Process**

This attribute is discussed in Section B.0.3.

**9. Administrative Controls**

This attribute is discussed in Section B.0.3.

**10. Operating Experience**

ASME Code, Section XI, Subsection IWE, was credited for ANO-1 license renewal. The program was reviewed by the NRC staff. The NRC staff agreed that even though limited operating experience was available, the program "provides reasonable assurance (for the SCs subject to an AMR) that the applicable aging effects will be adequately managed for the period of extended operation" (Reference B.2-3).

ASME Code, Section XI, Subsection IWL, was credited for ANO-1 license renewal. The program was reviewed by the NRC staff. The NRC staff noted that limited operating experience was available for review because Subsection IWL had only recently been implemented by the industry. The staff concluded that IWL provides reasonable assurance that aging of the applicable structures and components will be adequately managed for the period of extended operation (Reference B.2-3).

## Conclusion

The Containment Inservice Inspection Program provides reasonable assurance that the effects of aging will be managed such that the applicable components will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

## B.1.14 INSERVICE INSPECTION - INSERVICE INSPECTION

**Program Description**

The ANO-2 Inservice Inspection (ISI) Program is a plant-specific program encompassing ASME Section XI Subsection IWB, IWC, IWD and IWF requirements. A similar program for ANO-1 has previously been evaluated and approved by the NRC as documented in NUREG-1743 (Reference B.2-3).

In March, 2000 ANO-2 entered the third ISI interval and began implementing the applicable requirements of the 1992 Edition of ASME Section XI, with pressure testing criteria from the 1993 Addenda, approved NRC alternatives and relief requests, and other requirements specified in 10CFR50.55a.

**Evaluation**

1. **Scope of Program**

   The Inservice Inspection Program manages cracking, wear, loss of mechanical closure integrity, and loss of material of reactor coolant system piping and components, including reactor coolant pump items and austenitic stainless steel small bore piping. The program implements the applicable requirements of ASME Section XI, Subsections IWB, IWC, IWD, and IWF, and other requirements specified in 10CFR50.55a with approved NRC alternatives and relief requests. The Inservice Inspection Program is updated as required to the latest ASME Section XI code edition and addendum approved by the Nuclear Regulatory Commission in 10CFR50.55a.

2. **Preventive Actions**

   The Inservice Inspection Program is a monitoring program that does not include preventive actions.

3. **Parameters Monitored/Inspected**

   The program uses nondestructive examination (NDE) techniques to detect and characterize flaws. The three different types of examinations are volumetric, surface, and visual. Volumetric examinations are the most extensive, using methods such as radiographic, ultrasonic or eddy current examinations to locate surface and subsurface flaws. Surface examinations, such as magnetic particle or dye penetrant testing, are used to locate surface flaws. Three levels of visual examinations are specified. The VT-1 visual examination is conducted to assess the condition of the surface of the part being examined, looking for cracks and symptoms of wear, corrosion, erosion or physical damage. It can be done with either direct visual observation or with remote examination using various optical/video devices.

The VT-2 examination is conducted specifically to locate evidence of leakage from pressure retaining components (period pressure tests). While the system is under pressure for a leakage test, visual examinations are conducted to detect direct or indirect indication of leakage. The VT-3 examination is conducted to determine the general mechanical and structural condition of components and supports and to detect discontinuities and imperfections.

**4. Detection of Aging Effects**

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

The Inservice Inspection Program manages cracking of austenitic stainless steel small bore piping. Small bore piping and small bore nozzles are defined as piping and nozzles less than 4-inch NPS that do not normally receive volumetric inspection in accordance with ASME Section XI. The program includes inspection of selected RCS piping welds. The inspection of RCS piping appropriately addresses cracking of piping greater than 1-inch NPS for the period of extended operation.

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

The Inservice Inspection Program manages cracking of the shell, lower heads and nozzles, manway bolting, and supplements the Boric Acid Corrosion Prevention Program with regard to managing loss of material at external surfaces of the pressurizer. ASME Section XI Subsection IWB examination categories manage cracking and loss of material of the pressurizer pressure boundary and support items. This program manages cracking through a combination of visual, surface and volumetric examinations.

The Inservice Inspection Program manages cracking of the reactor vessel, lower head, closure head, nozzles, reactor vessel bolting, and supplements the Boric Acid Corrosion Prevention Program with regard to detecting loss of material at external surfaces of the reactor vessel and control element drive mechanism (CEDM) pressure boundary. ASME Section XI Subsection IWB examination categories manage cracking and loss of material of the reactor vessel and CEDM pressure boundary and support items. In addition to managing cracking, the Inservice Inspection Program detects degradation as a result of wear. Closure studs, washers, nuts, and threaded holes of the vessel closure flange are visually inspected for wear in accordance with ASME Section XI requirements.

The Inservice Inspection Program, under ASME Section XI Subsection IWB examination categories, manages cracking, wear, loss of preload, and loss of material of the reactor vessel internals items through visual examinations. Interior attachments and core support structures associated with the reactor vessel internals undergo a (VT-3) visual examination at the weld (for the attachments) and at the surface (for the core support structures) in accordance with ASME Section XI requirements.

The Inservice Inspection Program, under ASME Section XI Subsections IWB, IWC and IWD examination categories, manages cracking, wear, and loss of material of the steam generator pressure boundary and support items through a combination of visual, surface and volumetric examinations.

The Inservice Inspection Program, under ASME Section XI Subsection IWF examination categories, manages loss of material for ASME Class 1, 2, and 3 steel piping supports and steel component supports within containment.

The Inservice Inspection Program, under ASME Section XI Subsection IWF examination categories, manages loss of material for steel base plates, component supports, and threaded fasteners and cracking for threaded fasteners for ASME Class 1, 2, and 3 steel piping supports and steel component supports.

**5. Monitoring and Trending**

The Inservice Inspection Program does not require monitoring or trending of progressive, time-dependent degradation. Flaws detected are evaluated by comparing the examination results to the acceptance standards in ASME Boiler and Pressure Vessel Code Section XI. Unacceptable indications require detailed analyses, repair, or replacement. The ISI results are recorded and provided to the NRC in accordance with ASME Section XI requirements. Reports describe the scope of the inspection and significant inspection results.

**6. Acceptance Criteria**

If during the performance of an ISI examination, a flaw is discovered, an evaluation is conducted in accordance with articles IWA-3000, IWB-3000, IWC-3000, IWD-3000 or IWF-3000.

**7. Corrective Action**

If flaws exceed the acceptance standards, such flaws are removed, repaired or the component replaced prior to return of the component to service. For Class 1, 2, and 3, respectively, repair is in conformance with IWB-4000, IWC-4000, and IWD-4000, and replacement according to IWB-7000, IWC-7000, and IWD-7000. Acceptance of flaws which exceed acceptance criteria may be accomplished through analytical evaluation without repair, removal or replacement of the flawed component if the evaluation meets the criteria specified in the applicable article of the code.

**8. Confirmation Process**

This attribute is discussed in Section B.0.3.

**9. Administrative Controls**

This attribute is discussed in Section B.0.3.

**10. Operating Experience**

Condition report trending data did not identify a need for improvements to this program. A 2002 self assessment evaluated the ISI programs using the NRC Inspections Guideline 71111.08, Inservice Inspection Activities. Minor deficiencies were noted and resolved during the evaluation.

NRC inspectors observed portions of the 2R15 inservice inspection examinations. The inspectors verified that the correct procedure was used, requirements and conditions were as specified in the procedure, and test instrumentation and equipment were properly calibrated. The inspectors also verified that findings were compared to ASME Code specified acceptance standards and appropriately evaluated. No findings of significance were identified.

ASME Code, Section XI, Subsections IWB, IWC, IWD and IWF were credited for ANO-1 license renewal. The program was reviewed by the NRC staff who found that the operating experience with the ISI program (Subsections IWB, IWC, and IWD) indicates that it has been successful in identifying and leading to correction of aging effects. The NRC evaluation found that the program is effective in the management of age-related degradation (Reference B.2-3).

## Conclusion

The Inservice Inspection Program provides reasonable assurance that the effects of aging will be managed such that the applicable components will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

## B.1.15 NON-EQ INACCESSIBLE MEDIUM-VOLTAGE CABLE

**Program Description**

The Non-EQ Inaccessible Medium-voltage Cable Program at ANO-2 will be comparable to the program described in NUREG-1801, Section XI.E3, Inaccessible Medium-voltage Cables Not Subject to 10CFR50.49 Environmental Qualification Requirements.

In this aging management program, periodic actions will be taken to prevent cables from being exposed to significant moisture, such as inspecting for water collection in cable manholes and conduit, and draining water, as needed. In-scope medium-voltage cables exposed to significant moisture and voltage will be tested to provide an indication of the condition of the conductor insulation. The specific type of test performed will be determined prior to the initial test.

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

**NUREG-1801 Consistency**

The Non-EQ Inaccessible Medium-Voltage Cable Program will be consistent with the program described in NUREG-1801, Section XI.E3, Inaccessible Medium-Voltage Cables Not Subject To 10CFR50.49 Environmental Qualification Requirements.

**Operating Experience**

The Non-EQ Inaccessible Medium-Voltage Cable Program is a new program for which there is no operating experience.

**Conclusion**

The Non-EQ Inaccessible Medium-Voltage Cable Program will be effective for managing aging effects since it will incorporate appropriate monitoring techniques. The Non-EQ Inaccessible Medium-Voltage Cable Program will provide reasonable assurance that the effects of aging will be managed such that the applicable components will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation. The program will be initiated prior to the period of extended operation.

## B.1.16 NON-EQ INSULATED CABLES AND CONNECTIONS

### Program Description

The Non-EQ Insulated Cables and Connections Program at ANO-2 will be comparable to the program described in NUREG-1801, Section XI.E1, Electrical Cables and Connections Not Subject to 10CFR50.49 Environmental Qualification Requirements.

The Non-EQ Insulated Cables and Connections will provide reasonable assurance that the intended functions of insulated cables and connections exposed to adverse localized environments caused by heat, radiation and moisture can be maintained consistent with the current licensing basis through the period of extended operation. An adverse localized environment is significantly more severe than the specified service condition for the insulated cable or connection.

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

### NUREG-1801 Consistency

The Non-EQ Insulated Cables and Connections Program will be consistent with the program described in NUREG-1801, Section XI.E1, Electrical Cables and Connections Not Subject to 10CFR50.49 Environmental Qualification Requirements.

### Operating Experience

The Non-EQ Insulated Cables and Connections Program at ANO-2 is a new program for which there is no operating experience.

### Conclusion

The Non-EQ Insulated Cables and Connections Program will be effective for managing aging effects since it will incorporate proven monitoring techniques, acceptance criteria, corrective actions, and administrative controls. The Non-EQ Insulated Cables and Connections Program will provide reasonable assurance that the effects of aging will be managed such that the applicable components will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation. The program will be initiated prior to the period of extended operation.

## B.1.17 OIL ANALYSIS

**Program Description**

There is no corresponding NUREG-1801 program. This is a plant-specific program.

The purpose of the Oil Analysis Program is to ensure the oil environment in the mechanical systems is maintained to the required quality. The Oil Analysis Program maintains oil systems free of contaminants (primarily water and particulates) thereby preserving an environment that is not conducive to loss of material, cracking or fouling.

**Evaluation**

### 1. Scope of Program

On a periodic basis, this program samples lubricating oil from plant components subject to aging management review.

### 2. Preventive Actions

The Oil Analysis Program maintains oil systems free of contaminants (primarily water and particulates) thereby preserving an environment that is not conducive to aging mechanisms.

### 3. Parameters Monitored/Inspected

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

### 4. Detection of Aging Effects

Periodic sampling and compliance with the acceptance criteria provide assurance that lube oil contaminants do not exceed acceptable levels. This manages the aging effects of cracking, loss of material and fouling.

### 5. Monitoring and Trending

Oil analysis results are reviewed to determine if alert levels or limits have been reached or exceeded. This review also checks for unusual trends.

### 6. Acceptance Criteria

Particle concentration limits are based on industry standards such as SAE749D, ISO 4406, ISO 112218, and NAS 1638. Water concentration will not exceed 0.1%, based on the CRC Handbook of Lubrication definition of trace amount. Viscosity bands are based on a tolerance of 10% around the base viscosity of the lubricating oil. Metal limits by spectral analysis and ferrography will be based on original baseline data and manufacturer's recommendations.

### 7. Corrective Actions

If a limit is reached or exceeded, actions to address the condition are taken. These may include the following.

- Increased monitoring
- Vibration analysis
- Corrective maintenance
- Further laboratory analysis
- Notification of the appropriate system engineer
- Consider short term and long term corrective actions

### 8. Confirmation Process

This attribute is discussed in Section B.0.3.

### 9. Administrative Controls

This attribute is discussed in Section B.0.3.

### 10. Operating Experience

Condition report trending data did not identify a need for improvements to this program.

The ANO Oil Analysis Program credited for ANO-2 aging management reviews is the same program credited for ANO-1 license renewal. During review of the ANO-1 LRA, an NRC evaluation team looked at past test results and noted that the data was within specifications. The NRC evaluation team concluded that the oil analysis program is being implemented as described in plant procedures and is an effective preventive maintenance program.

**Conclusion**

The Oil Analysis Program activities are preventive aging management activities that assure potentially detrimental concentrations of water and particulates are not present in the oil. The Oil Analysis Program provides reasonable assurance that the aging effects associated with components exposed to lubricating oil environments will be managed such that the applicable components will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

## B.1.18 PERIODIC SURVEILLANCE AND PREVENTIVE MAINTENANCE

**Program Description**

There is no corresponding NUREG-1801 program. This is a plant-specific program.

The ANO-2 Periodic Surveillance and Preventive Maintenance Program consists of periodic inspections and tests that are relied on to manage aging effects that are not managed by other aging management programs. The preventive maintenance and surveillance testing activities are generally implemented through repetitive tasks or routine monitoring of plant operations.

**Evaluation**

1. **Scope of Program**

   The ANO-2 Periodic Surveillance and Preventive Maintenance Program, with regard to license renewal, includes those tasks credited with managing the aging effects identified in the aging management reviews.

2. **Preventive Actions**

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

3. **Parameters Monitored/Inspected**

   This program provides instructions for monitoring structures, systems, and components to detect degradation. Inspection and testing activities monitor various parameters including system flow, system pressure, surface condition, loss of material, presence of corrosion products, and signs of cracking.

4. **Detection of Aging Effects**

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

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

*LPSI and HPSI Pump Surveillance Testing and Inspection*

LPSI and HPSI pump surveillance testing manages fouling on the borated water side of heat exchanger tubing of LPSI and HPSI pump seal coolers and fouling on the raw water side of HPSI pump bearing housings internal surface.

Enhancement: The interior of the bearing housings for the HPSI pumps will be inspected for loss of material (including that due to selective leaching). Acceptance criteria and corrective actions will be specified.

*CSS Pump Seal Heat Exchanger Testing*

CSS pump seal heat exchanger testing manages fouling on the borated water side of the heat exchanger tubing.

*Containment Sump Inspection*

Containment sump inspection manages loss of material on stainless steel components in the containment sump.

*Containment Service Water Cooling Coils Inspection*

Periodic inspection of the external (air) side of containment service water cooling coils manages fouling and loss of material for the copper alloy cooling coils.

Enhancement: The work orders for cleaning and inspecting the cooling coils of 2VCC-2A/B/C/D will be enhanced to include inspections to confirm the following conditions:

- no corroded parts or areas, and
- no accumulation of dirt or sludge that would affect the cooling ability of the coil.

*Containment Service Water Cooling Coils Housing Inspection*

Periodic inspection of the interior and exterior of the cooling coil housing manages the effect of loss of material on carbon and stainless steel components. This includes inspection of the housing floor, coils, coil mounting bolts, frame, drain pans and flanges.

Enhancement: The work orders for cleaning and inspecting the housings of 2VCC-2A/B/C/D will be enhanced to include inspections of the interior and exterior of the housings to confirm the following conditions:

- no degradation of housing floor that would impact seismic qualification or affect required pressure boundary,

- no loose or degraded upper or lower coil mounting fasteners that would allow the coil to fall and block the drop out dampers if an earthquake were to occur, and
- no significant corrosion or degradation of exterior surfaces including the flanges of the service water coils, that could affect coil seismic qualification, required pressure boundary or the ability to transfer the required heat load.

*Monthly Electrical Penetration Nitrogen Leak Rate Test*

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

*Emergency Diesel Generator Maintenance Inspections*

Emergency diesel generator maintenance inspections manage loss of material (including that due to selective leaching), cracking, fouling and change in material properties for various materials.

*Emergency Diesel Generator Surveillance Testing*

Emergency diesel generator surveillance testing manages fouling on air and treated water sides of EDG air cooler heat exchangers.

*Chemical and Volume Control System Periodic Surveillance Testing*

Chemical and volume control system periodic surveillance testing manages loss of material of charging pump casings.

*Alternate AC Diesel Generator Maintenance Inspections*

Alternate AC diesel generator maintenance inspections manage loss of material (including that due to selective leaching), cracking and change in material properties for various materials.

*Alternate AC Diesel Generator Surveillance Testing*

Alternate AC diesel generator surveillance testing manages fouling on heat exchanger tubing of the engine cooling water radiator, aftercooler heat exchanger and lube oil heat exchanger.

*CPC Room Halon System Inspection*

The CPC room halon system visual inspection manages loss of material for external and internal surfaces of carbon steel components. The external surface condition is representative of the internal surface condition since both have the same environment.

*RCP Motor Oil Leakage Collection System Inspection*

The RCP motor oil leakage collection system visual inspection manages loss of material for carbon steel and stainless steel components.

*Maintenance Inspections of Fuel Oil System Components*

Maintenance inspections of fuel oil system components manage loss of material, cracking and change in material properties for various materials.

*Diesel Generator Surveillance Testing*

Diesel generator surveillance testing manages fouling on the heat exchanger tubing of the diesel fuel oil return cooler.

*Service Water System Surveillance Testing*

Service water system surveillance testing manages loss of material on bolting, filters and pump casings.

*Auxiliary Building Ventilation System Testing*

Auxiliary building ventilation system testing manages fouling on both the water and air sides of copper alloy cooling coils, loss of material for external copper alloy cooling coil surfaces and loss of material for internal surfaces of the carbon steel cooling coil housing. Auxiliary building ventilation system testing manages change in material properties and cracking of elastomer flexible connections.

*Control Room Ventilation System Testing*

Control room ventilation system testing manages loss of material and fouling for copper alloy, carbon steel and stainless steel components. Control room ventilation system testing manages cracking and change in material properties of elastomer flexible connections.

*Emergency Feedwater System Testing and Inspections*

Emergency feedwater system testing and inspections manages loss of material and fouling on carbon steel and copper components in the emergency feedwater system.

*2D11, 2D12 and 2D13 Battery Rack Inspection*

Battery rack inspection manages loss of material for in-scope battery racks.

*Annual Emergency Cooling Pond Sounding*

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

**5. Monitoring and Trending**

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

**6. Acceptance Criteria**

Periodic Surveillance and Preventive Maintenance Program acceptance criteria are defined in specific inspection and testing procedures. They confirm component integrity by verifying the absence of aging effect or by comparing applicable parameters to limits based on applicable intended functions established by the plant design basis.

**7. Corrective Actions**

The site Corrective Action Program, quality assurance procedures, site review and approval process, and administrative controls are implemented in accordance with the requirements of 10 CFR Part 50, Appendix B.

**8. Confirmation Process**

This attribute is discussed in Section B.0.3.

**9. Administrative Controls**

This attribute is discussed in Section B.0.3.

**10. Operating Experience**

The ANO-2 history of successful operation demonstrates that typical surveillance and preventive maintenance activities have been effective in managing the effects of aging on components.

**Enhancements**

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

| Attributes Affected | Enhancements |
|---|---|
| 1. Scope<br>4. Detection of Aging Effects | The interior of the bearing housings for HPSI pumps will be inspected for loss of material (including that due to selective leaching). Acceptance criteria and corrective actions will be specified. |
| 1. Scope<br>4. Detection of Aging Effects | The work orders for cleaning and inspecting the cooling coils of 2VCC-2A/B/C/D will be enhanced to include inspections to confirm the following conditions.<br>• No corroded parts or areas<br>• No accumulation of dirt or sludge that would affect the cooling ability of the coil. |
| 1. Scope<br>4. Detection of Aging Effects | The work orders for cleaning and inspecting the housings of 2VCC-2A/B/C/D will be enhanced to include inspections of the interior and exterior of the housings to confirm the following conditions.<br>• No degradation of housing floor that would impact seismic qualification or affect required pressure boundary<br>• No loose or degraded upper or lower coil mounting fasteners that would allow the coil to fall and block the drop out dampers if an earthquake were to occur.<br>• No significant aging of exterior surfaces including the flanges of the service water coils, that could affect the coil seismic qualification, required pressure boundary or the ability to transfer the required heat load. |

| Attributes Affected | Enhancements |
|---|---|
| 1. Scope<br>4. Detection of Aging Effects | The work order for the CPC room halon test will be enhanced to include inspection of external surfaces of the carbon steel components for excessive corrosion. |

**Conclusion**

The Periodic Surveillance and Preventive Maintenance Program will be effective for managing aging effects since it consists of proven monitoring techniques, acceptance criteria, corrective actions, and administrative controls. The Periodic Surveillance and Preventive Maintenance Program provides reasonable assurance that the effects of aging will be managed such that the applicable components will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

## B.1.19 PRESSURIZER EXAMINATIONS

**Program Description**

There is no corresponding NUREG-1801 program. This will be a plant-specific program.

Cracking of pressurizer cladding (and items attached to the cladding) may propagate into underlying ferritic steel. The purpose of the pressurizer examinations will be to identify this cracking, which could potentially cause loss of intended function of the pressurizer. Alloy 600 small bore nozzles are addressed in the Alloy 600 Aging Management Program.

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

**Evaluation**

1. **Scope of Program**

   The Pressurizer Examinations Program will manage cracking of the stainless steel and nickel-based alloy cladding and attachment welds to the cladding of the pressurizer by examination of the adjacent base metal. The pressurizer shell and upper head are clad with austenitic stainless steel. The lower head is clad with nickel-based alloy.

2. **Preventive Actions**

   While no actions will be taken as part of this program to prevent aging effects or mitigate aging degradation, ANO-2 water chemistry control programs include effective actions to avoid stress corrosion cracking (SCC) of the cladding and attachment welds.

3. **Parameters Monitored/Inspected**

   In order to provide assurance that cracking of the pressurizer cladding has not propagated into the underlying base metal of the pressurizer, volumetric examination of pressurizer items that are susceptible to cracking will be performed. Cracking of the pressurizer stainless steel cladding would most likely result from thermal fatigue and cracking of the nickel-based alloy cladding would most likely result from PWSCC and fatigue. The pressurizer pressure boundary items with high fatigue cumulative usage factors include the circumferential weld at the head to shell junction and the surge nozzle to shell junction.

   In accordance with ASME Section XI, Examination Category B-B, volumetric examination of essentially 100% of the circumferential shell-to-head weld will be performed. In addition, the weld metal between the surge nozzle and the vessel lower head will be subjected to high stress cycles. Periodic monitoring of this area provides monitoring for cracking of the nickel-based alloy cladding that may propagate to the underlying ferritic steel. The weld that connects the surge nozzle to the lower head will receive volumetric examination in accordance with Examination Category B-D. These examinations will continue through the period of extended operation to manage cracking of cladding that may extend into the base metal at susceptible locations. In addition, the nickel-based alloy cladding covering the lower head of the pressurizer will be included in the Alloy 600 Aging Management Program.

**4. Detection of Aging Effects**

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

**5. Monitoring and Trending**

During the course of the inspections, the extent of surface or volumetric flaws will be characterized by non-destructive examinations. Anomalous indications that are signs of degradation will be recorded on non-destructive examination reports in accordance with plant procedures.

**6. Acceptance Criteria**

The acceptance criteria for volumetric examinations will be in accordance with ASME Section XI, IWB-3510 and IWB-3512.

**7. Corrective Actions**

Specific corrective actions will be implemented in accordance with the corrective action program and ASME Section XI. In accordance with Subsection IWB, components containing relevant indications shall be evaluated, repaired, or replaced prior to returning to service.

**8. Confirmation Process**

This attribute is discussed in Section B.0.3.

**9. Administrative Controls**

This attribute is discussed in Section B.0.3.

### 10. Operating Experience

As a result of pressurizer clad cracking at Haddam Neck, cracking of cladding in the pressurizer was considered an aging effect requiring management. The concern is that cracks in the cladding may extend into the underlying ferritic steel and subsequent growth of the crack may propagate and result in loss of intended function.

The Pressurizer Examinations Program will include volumetric examinations of pressurizer items having high susceptibility to thermal fatigue. Cracking of the cladding that extends into the base metal would be detected by ASME Section XI volumetric examinations at these locations. The volumetric inspections will be performed with ISI techniques that have been proven effective within the industry at detecting cracking before loss of function occurs.

The Pressurizer Examinations Program is based on proven ISI techniques that can effectively manage cracking of pressurizer cladding. This program will provide reasonable assurance that the aging effects will be managed so that the pressurizer will continue to perform its intended functions consistent with the current licensing basis for the period of extended operation.

## Conclusion

The Pressurizer Examinations Program will be initiated prior to the period of extended operation. It will be capable of managing cracking in the cladding that could extend into the underlying ferritic steel. The Pressurizer Examinations Program will provide reasonable assurance that the aging effects associated with the cladding and ferritic base material will be managed such that the applicable components will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

## B.1.20 REACTOR VESSEL HEAD PENETRATION

**Program Description**

The Reactor Vessel Head Penetration Program at ANO-2 is comparable to the aging management program described in NUREG-1801, Section XI.M11, Nickel-Alloy Nozzles and Penetrations.

The purpose of the Reactor Vessel Head Penetration Program is to manage cracking of nickel-based alloy reactor vessel head penetrations exposed to borated water to assure that the pressure boundary function is maintained during the period of extended operation. The Inservice Inspection and the Water Chemistry Control Programs are used in conjunction with this program to manage cracking of the reactor vessel head penetrations.

**NUREG-1801 Consistency**

The Reactor Vessel Head Penetration Program is consistent with the program described in NUREG-1801, Section X.M11, Nickel-Alloy Nozzles and Penetrations.

**Operating Experience**

The Corrective Action Program has been used to incorporate industry operating experience into this program. Inspections based on industry operating experience identified cracks at reactor vessel head penetration weld locations on ANO-1. The Corrective Action Program was used to develop inspection requirements specific to ANO-2.

ANO to NRC letter (0CAN040201) dated April 1, 2002, “15-Day Response to NRC Bulletin 2002-01, Reactor Pressure Vessel Head Degradation and Reactor Coolant Pressure Boundary Integrity,” provided the ANO response to the NRC regarding potential head degradation issues applicable to ANO-2.

An assessment of the examination of ANO reactor pressure vessel head penetration nozzles was completed in 2002. This assessment concluded that the examination of the ANO-2 reactor vessel head penetration nozzles during 2R15 was performed in accordance with the commitments in the ANO-2 response to NRC Bulletin 2001-01.

**Conclusion**

The Reactor Vessel Head Penetration Program has been demonstrated capable of managing aging of nickel based alloy reactor vessel head penetrations. The Reactor Vessel Head Penetration Program provides reasonable assurance that the effects of aging will be managed such that the applicable components will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

## B.1.21 REACTOR VESSEL INTEGRITY

**Program Description**

The Reactor Vessel Integrity Program is analogous to the program described in NUREG-1801, Section XI.M31, Reactor Vessel Surveillance.

The purpose of the Reactor Vessel Integrity Program is to manage reduction of fracture toughness of reactor vessel beltline materials to assure that the pressure boundary function of the reactor vessel is maintained for the period of extended operation. The program is based on ASTM E-185-82, “Recommended Practice for Surveillance Tests for Nuclear Reactor Vessels”, and includes an evaluation of radiation damage based on pre-irradiation and post irradiation testing of Charpy V-notch and tensile specimens. The ANO-2 reactor vessel has surveillance capsule assemblies positioned near the inside wall of the reactor vessel, centered at the core mid-plan, so that the flux spectrum, fluence, and temperature of the specimens resembles the conditions experienced by the reactor vessel wall.

In order to estimate reactor vessel fast neutron fluence within the reactor vessel beltline region, fission threshold detectors are inserted into each surveillance capsule to monitor fast neutron flux. The calculated neutron spectrum is obtained from plant-specific neutron transport calculations performed in accordance with requirements of NRC Regulatory Guide 1.190. From the resulting capsule fluence levels, the corresponding fast neutron fluence (E>1.0 MeV) for the pressure vessel is calculated.

In addition, thermal monitors made of low melting alloys are included to monitor temperature of the specimens. Under the Reactor Vessel Integrity Program, reports are submitted as required by 10 CFR Part 50 Appendix H. Reports include a capsule withdrawal schedule, a summary report of capsule withdrawal and test results and, if needed, a date for when Technical Specification changes are required to account for changing pressure-temperature limits. The $RT_{PTS}$ analysis is updated as required by 10CFR50.61. Pressure-temperature curves are maintained in plant Technical Specifications. As surveillance capsules are withdrawn and either tested or stored, documentation is updated and submitted to the NRC in accordance with 10 CFR 50, Appendix G.

ANO-2 complies with the requirements of 10CFR50.60, Appendices G and H, and 10CFR50.61, through the Reactor Vessel Integrity Program.

**NUREG-1801 Consistency**

The Reactor Vessel Integrity Program meets the intent of NUREG-1801, Section XI.M31, Reactor Vessel Surveillance.

**Enhancements**

The following enhancement will be initiated prior to the period of extended operation.

| Attributes Affected | Enhancement |
|---|---|
| Paragraph 5 of NUREG-1801 program XI.M31. | The ANO-2 specimen capsule withdrawal schedule will be revised to withdraw and test a standby capsule to cover the peak fluence expected through the end of the period of extended operation. |

**Operating Experience**

An assessment of the Reactor Vessel Integrity Program for ANO-2 to determine compliance with federal law, regulatory requirements, and licensing commitments was performed in 2002. Configuration controls and management of site documentation were evaluated. The self assessment found that the current program for ANO-2 provides directions, instructions, criteria, and related historical data in regards to fracture prevention for the reactor vessel set forth by federal law and regulatory requirements and commitments currently in-place for ANO-2.

**Conclusion**

The Reactor Vessel Integrity Program is capable of ensuring that reactor vessel degradation is identified and corrective actions are taken prior to exceeding allowable limits. The Reactor Vessel Integrity Program provides reasonable assurance that the effects of aging will be managed such that the applicable components will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

## B.1.22 REACTOR VESSEL INTERNALS CAST AUSTENITIC STAINLESS STEEL COMPONENTS

### Program Description

The Reactor Vessel Internals Cast Austenitic Stainless Steel Components Program at ANO-2 will be comparable to the program described in NUREG-1801, Section XI.M13, Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS).

The purpose of the RVI CASS Components Program will be to manage the effects of loss of fracture toughness of CASS reactor vessel internals. The program will include identification of the most limiting susceptible components. For each identified component, aging management is accomplished through either a supplemental examination of the affected component based on the neutron fluence to which the component has been exposed or a component-specific evaluation to determine its susceptibility to loss of fracture toughness. This program will supplement the reactor vessel internals inspections required by ASME Section XI.

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

### NUREG-1801 Consistency

The Reactor Vessel Internals

Cast Austenitic Stainless Steel Components Program will be consistent with the program described in NUREG-1801, Section XI.M13, Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel.

### Operating Experience

The Reactor Vessel Internals Cast Austenitic Stainless Steel Components Program at ANO-2 is a new program for which there is no operating experience.

Compliance with the inspection requirements of ASME Section XI has been maintained at ANO-2 since initial operation. The visual examinations to be performed by this program are inspections with demonstrated capability to detect cracking.

### Conclusion

The Reactor Vessel Internals Cast Austenitic Stainless Steel Components Program will provide reasonable assurance that the aging effects associated with the reactor vessel internals items fabricated from CASS will be managed such that the applicable components will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation. The program will be initiated prior to the period of extended operation.

## B.1.23 REACTOR VESSEL INTERNALS STAINLESS STEEL PLATES, FORGINGS, WELDS, AND BOLTING

### Program Description

The Reactor Vessel Internals Stainless Steel Plates, Forgings, Welds, and Bolting Program at ANO-2 will be comparable to the program described in NUREG-1801, Section XI.M16, PWR Vessel Internals.

The purpose of the Reactor Vessel Internals Stainless Steel Plates, Forgings, Welds, and Bolting Program will be to manage the effects of crack initiation and growth, loss of fracture toughness, and distortion. Loss of fracture toughness is only a concern if cracks exist. Cracking is expected to initiate at the surface and is detectable by inspection. This program will provide visual inspections and non-destructive examinations of the reactor vessel internals during the period of extended operation. In addition, the investigation of the reactor vessel internals aging effects through the activities of EPRI and other industry groups will ensure a better understanding of the identified aging effects. This program will supplement the reactor vessel internals inspections required by the ASME Section XI Inservice Inspection Program.

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

### NUREG-1801 Consistency

The Reactor Vessel Internals Stainless Steel Plates, Forgings, Welds, and Bolting Program will be consistent with the program described in NUREG-1801, Section XI.M16, PWR Vessel Internals.

### Operating Experience

The Reactor Vessel Internals Stainless Steel Plates, Forgings, Welds, and Bolting Program is a new program for which there is no operating experience. However, compliance with the inspection requirements of ASME Section XI has been maintained at ANO-2 since initial operation. The visual examinations to be performed in accordance with this program are proven techniques to detect cracking.

**Conclusion**

The Reactor Vessel Internals Stainless Steel Plates, Forgings, Welds, and Bolting Program will provide reasonable assurance that the effects of aging will be managed such that the applicable components will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation. The program will be initiated prior to the period of extended operation.

## B.1.24 SERVICE WATER INTEGRITY

**Program Description**

The Service Water System Integrity Program at ANO-2 is comparable to the program described in NUREG-1801, Section XI.M20, Open-Cycle Cooling Water System.

This program relies on implementation of the recommendations of NRC Generic Letter (GL) 89-13 to ensure that the effects of aging on the service water (SW) system will be managed for the period of extended operation. The program includes surveillance and control techniques to manage aging effects caused by biofouling, corrosion, erosion, protective coating failures, and silting in the SW system or structures and components serviced by the SW system.

**NUREG-1801 Consistency**

With enhancement, the Service Water Integrity Program will be consistent with, but include exceptions to, NUREG-1801, Section XI.M20, Open-Cycle Cooling Water System.

**Exceptions to NUREG-1801**

The program attributes of the Service Water Integrity Program at ANO-2 are consistent with the program attributes described in NUREG-1801, Section XI.M20, Open-Cycle Cooling Water System with the following exceptions and enhancements.

| Attributes Affected | Exception |
|---|---|
| 2. Preventive Actions | NUREG-1801 states that system components are lined or coated. Components are lined or coated only where necessary to protect the underlying metal surfaces.<br>(Note 1) |
| 5. Monitoring and Trending | NUREG-1801 requires testing and inspections performed annually and during refueling outages. The ANO-2 program requires tests and inspections based on inspection results at various frequencies. (Note 2) |

1) NUREG-1801 states that system components are constructed of appropriate materials and lined or coated to protect the underlying metal surfaces from being exposed to aggressive cooling water environments. Not all ANO-2 system components are lined or coated. They are lined or coated only where necessary to protect the underlying metal surfaces. This meets the intent of NUREG-1801.
2) NUREG-1801 program entails testing and inspections performed annually and during refueling outages. The ANO-2 program requires tests and inspections based on inspection results at various frequencies. Since aging effects are typically manifest over several years, the change in inspection and testing frequency is insignificant.

**Enhancements**

The following enhancement will be initiated prior to the period of extended operation.

| Attributes Affected | Enhancement |
|---|---|
| 4. Detection of Aging Effects | The Service Water System Integrity Program will be enhanced to check for evidence of selective leaching during visual inspections. |

**Operating Experience**

Condition reports documenting minor through wall piping leaks in the ANO-2 service water system and trending data demonstrate that service water system components are routinely inspected to ensure that loss of material and cracking will not degrade the ability of the service water system to perform its intended function.

During review of the ANO-1 LRA, the NRC staff evaluated acceptance criteria for the service water chemistry control program (Ref. Safety Evaluation Report Related to the License Renewal of Arkansas Nuclear One, Unit 1, April 2001). Sampling parameters, sampling locations, and the plant operating conditions were included in the evaluation. The NRC staff found that the acceptance criteria have low thresholds to allow for the early detection and correction of water chemistry deviations.

**Conclusion**

With enhancement the Service Water Integrity Program will provide reasonable assurance that the effects of aging will be managed such that the applicable components will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

## B.1.25 STEAM GENERATOR INTEGRITY

### Program Description

The Steam Generator Integrity Program at ANO-2 is comparable to the program described in NUREG-1801, Section XI.M19, Steam Generator Tube Integrity.

In the industry, steam generator (SG) tubes have experienced degradation related to corrosion phenomena, such as primary water stress corrosion cracking (PWSCC), outside diameter stress corrosion cracking (ODSCC), intergranular attack (IGA), pitting, and wastage, along with other mechanically induced phenomena, such as denting, wear, impingement damage, and fatigue. Nondestructive examination (NDE) techniques are used to identify tubes that are defective and need to be removed from service or repaired in accordance with the guidelines of the plant technical specifications.

### NUREG-1801 Consistency

The Steam Generator Integrity Program is consistent with the program described in NUREG-1801, Section XI.M19, Steam Generator Tube Integrity.

### Operating Experience

Condition reports document that the ANO-2 SG tube eddy current inspections are effective in identifying the effects of aging. Because of the aging effects identified through the program, the steam generators were replaced in 2000.

A quality assurance surveillance in 2000 evaluated the Steam Generator Integrity Program. The overall results of the surveillance were satisfactory. QA determined that the minor deficiencies identified were administrative.

### Conclusion

The Steam Generator Integrity Program provides reasonable assurance that the effects of aging will be managed such that the applicable components will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

## B.1.26 STRUCTURES MONITORING - MASONRY WALL

### Program Description

The Masonry Wall Program at ANO-2 is comparable to the program described in NUREG-1801, Section XI.S5, Masonry Wall Program.

The objective of the masonry wall program is to manage aging effects so that the evaluation basis established for each masonry wall within the scope of license renewal remains valid through the period of extended operation.

At ANO-2, masonry walls are inspected as part of the Structures Monitoring Program conducted for the maintenance rule, 10CFR50.65.

### NUREG-1801 Consistency

The Masonry Wall Program is consistent with the program described in NUREG-1801, Section XI.S5, Masonry Wall Program.

### Operating Experience

The requirements of this program are encompassed by the Structures Monitoring Program. The operating experience applicable to the Structures Monitoring Program is directly applicable to this program.

### Conclusion

The Masonry Wall Program has been effective at managing aging effects. The program employs visual inspection techniques that have proven effective in the industry at detecting aging effects on masonry walls. The Masonry Wall Program will provide reasonable assurance that the effects of aging will be managed such that the applicable components will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

## B.1.27 STRUCTURES MONITORING - STRUCTURES MONITORING

### Program Description

The Structures Monitoring Program at ANO-2 is comparable to the program described in NUREG-1801, Section XI.S6, Structures Monitoring Program.

Structures monitoring in accordance with 10CFR50.65 (the maintenance rule) is addressed in NRC Regulatory Guide (RG) 1.160, Rev. 2, and NUMARC 93-01, Rev. 2. These two documents provide guidance for development of licensee-specific programs to monitor the condition of structures and structural components within the scope of the maintenance rule, such that there is no loss of structure or structural component intended function.

Since protective coatings are not relied upon to manage the effects of aging for structures included in the structures monitoring program, the program does not address protective coating monitoring and maintenance.

### NUREG-1801 Consistency

The Structures Monitoring Program is consistent with the program described in NUREG-1801, Section XI.S6, Structures Monitoring Program.

### Operating Experience

Site personnel use the Corrective Action Program to identify deficient conditions and to establish the appropriate corrective actions. For example, when rusted structural materials are identified, when unpainted structural surfaces are found, and when missing coatings are identified, the Corrective Action Program provides for resolution of the conditions. In another example, damaged floor coating was identified and resolved by the Corrective Action Program.

A maintenance rule walkdown for evaluation of structures in 1999 provides evidence of the effectiveness of the Structures Monitoring Program in managing the effects of aging. The necessary walkdowns were performed, the results were documented and CRs were issued as necessary.

### Conclusion

The Structures Monitoring Program provides reasonable assurance that the effects of aging will be managed such that the applicable components will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

## B.1.28 SYSTEM WALKDOWN

**Program Description**

There is no corresponding NUREG-1801 program. This is a plant-specific program.

System walkdowns are conducted to manage aging effects on systems and components within the scope of license renewal and subject to aging management review.

**Evaluation**

**1. Scope of Program**

This program includes inspections of external surfaces of ANO-2 components within the scope of license renewal and subject to aging management review. The program is also credited with managing loss of material from internal surfaces, for situations in which the external surface condition is representative of the internal surface condition and both have the same environment.

The System Walkdown Program is also credited with detecting leakage and spray from liquid-filled low-energy systems before such leakage can prevent satisfactory accomplishment of safety functions.

**2. Preventive Actions**

The System Walkdown Program is a monitoring program that does not include preventive actions.

**3. Parameters Monitored/Inspected**

During a walkdown, the engineer monitors for items which could affect system performance, safety, or reliability as well as general housekeeping, personnel safety hazards and radiological concerns. Examples of parameters inspected during the system walkdowns are

- condition and placement of coatings,
- evidence of corrosion, and
- indications of leakage.

**4. Detection of Aging Effects**

A general visual inspection is conducted on readily accessible system and component surfaces during walkdowns. Component walkdowns are performed periodically at a frequency dependant on the component being inspected. For each system that credits the System Walkdown Program, system engineers are expected to perform a walkdown at least once per refueling cycle. This frequency is acceptable since aging effects are typically caused by long-term degradation mechanisms such as corrosion.

**5. Monitoring and Trending**

The System Walkdown Program uses standardized monitoring and trending activities to track degradation. Deficiencies are documented so that results can be trended. In addition to preparing a written description and noting the location, this may also include collecting measurements to determine the severity of deterioration, taking photographs, or drawing sketches.

Component inspections are conducted under the System Walkdown Program by qualified engineers using predefined checklists. Personnel are qualified in accordance with the Engineering Support Personnel (ESP) Training Program that provides assurance of an appropriate level of knowledge and experience prior to performing engineering activities.

**6. Acceptance Criteria**

No unacceptable visual indications of cracking, loss of material, or change of material properties of components.

**7. Corrective Actions**

Deficiencies identified during a walkdown are documented using the appropriate corrective action document. Corrective actions are accomplished in accordance with the site Corrective Action Program.

**8. Confirmation Process**

This attribute is discussed in Section B.0.3.

**9. Administrative Controls**

This attribute is discussed in Section B.0.3.

**10. Operating Experience**

Condition reports document conditions identified during walkdowns including corrosion, paint flaking, excessive wear, plant environment issues, leakage, loose parts, bent or broken parts, and numerous other low-level material conditions. Condition report trending data did not identify a need for improvement to this program. Operating experience demonstrates that under the System Walkdown Program, coating deficiencies, evidence of corrosion and indications of leakage are detected and corrective action is initiated as required.

The Structures and System Walkdown Program was credited for ANO-1 license renewal as documented in Section 3.3.1.3 of NUREG-1743 (Reference B.2-3). The ANO-1 program, which was referred to as the Maintenance Rule Program, included system walkdowns and structures monitoring. The system walkdown portion of the approved ANO-1 program is equivalent to the ANO-2 System Walkdown Program. The NRC staff reviewed the ANO-1 program and found that the program can manage applicable aging effects of loss of material, cracking, change in material properties, and loss of mechanical closure integrity. Therefore, there is reasonable assurance that the commodities and components covered by the ANO-2 program will perform their intended functions in accordance with the current licensing basis for the period of extended operation.

**Conclusion**

The System Walkdown Program uses visual inspections to identify aging effects and aging mechanisms that could cause aging effects. These include corrosion and indications of leakage. Visual inspections have proven effective throughout the industry in managing aging effects on plant equipment. The System Walkdown Program provides reasonable assurance that the effects of aging will be managed such that the applicable components will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

## B.1.29 WALL THINNING MONITORING

**Program Description**

There is no corresponding NUREG-1801 program. A similar wall thinning program has previously been evaluated and approved by the NRC as documented in NUREG-1743, Safety Evaluation Report Related to the License Renewal of Arkansas Nuclear One, Unit 1.

The Wall Thinning Monitoring Program inspections will be performed to ensure wall thickness is above the minimum required in order to avoid failures under normal, transient and accident conditions, including seismic events.

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

**Evaluation**

1. **Scope of Program**

   Wall thinning monitoring inspections cover carbon and stainless steel components.

2. **Preventive Actions**

   This will be an inspection program and no actions will be taken as part of this program to prevent or mitigate aging degradation.

3. **Parameters Monitored/Inspected**

   Non-destructive examinations will be performed on susceptible components to determine wall thickness.

4. **Detection of Aging Effects**

   The aging effect being managed by this program is loss of material. An appropriate sample size will be determined based on operating experience prior to these inspection activities. The extent and schedule of the examinations prescribed by the program will be designed to ensure that aging effects will be discovered and repaired before loss of intended function.

   Inspections will be performed periodically at a frequency to be determined prior to implementation. The frequency of inspections will depend upon results of previous inspections, calculated rate of material loss, and industry and plant operating experience.

**5. Monitoring and Trending**

Wall thickness will be trended and projected to the next inspection. Corrective actions will be taken if the projections indicate that the acceptance criteria may not be met at the next inspection.

**6. Acceptance Criteria**

Wall thickness measurements greater than minimum wall thickness values for the components' design code of record will be acceptable.

**7. Corrective Actions**

Corrective actions will be accomplished as necessary in accordance with the site corrective action program. This program will be administered under the site QA program which meets the requirements of 10 CFR Part 50, Appendix B.

**8. Confirmation Process**

This attribute is discussed in Section B.0.3.

**9. Administrative Controls**

This attribute is discussed in Section B.0.3.

**10. Operating Experience**

The Wall Thinning Monitoring Program at ANO-2 is a new program for which there is no operating experience.

**Conclusion**

The Wall Thinning Monitoring Program will be effective for managing aging effects since it incorporates proven monitoring techniques, acceptance criteria, corrective actions, and administrative controls from existing programs and procedures. The Wall Thinning Monitoring Program will provide reasonable assurance that the effects of aging will be managed such that the applicable components will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation. The program will be initiated prior to the period of extended operation.

## B.1.30 WATER CHEMISTRY CONTROL

The Water Chemistry Control Program encompasses three programs: Auxiliary Systems Water Chemistry Control, Closed Cooling Water Chemistry Control, and Primary and Secondary Water Chemistry Control.

### B.1.30.1 Auxiliary Systems Water Chemistry Control

**Program Description**

There is no corresponding NUREG-1801 program. This is a plant-specific program.

The purpose of the Auxiliary Systems Water Chemistry Control program is to manage loss of material, cracking, and fouling of components exposed to treated water environments.

**Evaluation**

1. **Scope of Program**

   The Auxiliary Systems Water Chemistry Control Program sampling activities include analyses on the emergency diesel generator and alternate AC diesel generator cooling water systems. In addition, the program includes chemistry monitoring and inspection activities on selected systems included in the scope of license renewal due to possible spatial interactions with safety-related systems. These systems are systems containing treated water that are not covered by other chemistry programs.

2. **Preventive Actions**

   This program monitors and controls water chemistry in the cooling water systems to manage the effects of aging.

3. **Parameters Monitored/Inspected**

   Typical parameters that are monitored include pH, conductivity, solids, hardness, nitrite, freeze point, and biological count.

   This program inspects components for visible corrosion, deposits, structural damage, and biological growth. The systems are inspected when opened for maintenance.

4. **Detection of Aging Effects**

   This program manages aging effects in the systems included in the scope.

5. **Monitoring and Trending**

   Values from analyses are archived for long-term trending and review.

6. **Acceptance Criteria**

The acceptance criteria for chemistry parameters are in accordance with the manufacturer's recommendations or industry guidelines.

The acceptance criteria for visual inspections are satisfactory general cleanliness and no unacceptable corrosion, deposits of structural damage.

7. **Corrective Action**

If acceptance criteria are not met, chemistry parameters are adjusted as appropriate. Additional sampling and verification is performed if necessary. Corrective actions for unacceptable inspection results are carried out in accordance with the Corrective Action Program.

8. **Confirmation Process**

This attribute is discussed in Section B.0.3.

9. **Administrative Controls**

This attribute is discussed in Section B.0.3.

10. **Operating Experience**

During review of the ANO-1 LRA (0CNA040109), an NRC review team reviewed the ANO Auxiliary Systems Water Chemistry Control Program. The governing procedure for the Auxiliary Systems Water Chemistry Program applies to both ANO-1 and ANO-2. The team reviewed the requirements contained in the program procedures and discussed these requirements with site personnel. The team found the procedures required sampling and testing of the closed cooling water loops water chemistry at specified frequencies. The water in the applicable closed loop cooling water systems is sampled and the control parameters (i.e., pH, iron, copper, biological activity, etc.) are monitored and trended. Based on these trends, corrective action is taken when a control parameter is outside of the acceptable range. The team reviewed the test results and trends from the water samples from the closed loop cooling water systems included in the scope of license renewal. The team found that the water chemistry control parameters from these water samples were maintained within the acceptable range and that appropriate corrective action was taken when control parameters were found outside the acceptable range.

**Conclusion**

The Auxiliary Systems Water Chemistry Control Program has been effective at managing loss of material for components exposed to treated water. The Auxiliary Systems Water Chemistry

Control Program provides reasonable assurance that the effects of aging will be managed such that the applicable components will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

### B.1.30.2 Closed Cooling Water Chemistry Control

#### Program Description

The Closed Cooling Water Chemistry Control Program at ANO-2 is comparable to the program described in NUREG-1801, Section XI.M21, Closed-Cycle Cooling Water System.

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

#### NUREG-1801 Consistency

The Closed Cooling Water Chemistry Control Program is consistent with, but includes exceptions to the program described in NUREG-1801, Section XI.M21, Closed-Cycle Cooling Water System.

#### Exceptions to NUREG-1801

The program attributes of the Closed Cooling Water Chemistry Control Program at ANO-2 are consistent with the program attributes described in NUREG-1801, Section XI.M21, Closed-Cycle Cooling Water System, with the following exceptions:

| Attributes Affected | Exception |
|---|---|
| 3. Parameters Monitored/Inspected | The ANO-2 parameters monitored and inspected are chemistry parameters only. (Notes 1 and 2) |
| 4. Detection of Aging Effects | The ANO-2 program is a preventive program that claims no credit for the detection of aging effects through performance and functional testing. (Note 3) |
| 5. Monitoring and Trending | The ANO-2 monitoring and trending addresses chemistry parameters only. (Notes 1 and 2) |
| 6. Acceptance Criteria | The ANO-2 acceptance criteria consider chemistry parameters only. (Notes 1 and 2) |
| | The nitrite corrosion inhibitor concentrations are maintained within specified limits, which allow for larger variances than recommended in EPRI TR-107396. 1200 ppm – 4000 ppm vs. EPRI of 500 ppm – 1000 ppm. (Note 2) |

1) While TR-107396 mentions that heat transfer testing can be used, it does not suggest monitoring pump performance parameters. The ANO-2 program monitors the chemistry parameters recommended in EPRI TR-107396.

2) Based on ANO-2 operating experience, there is reasonable assurance that monitoring these parameters will adequately manage aging effects on the closed cooling water systems.

3) Aging effects on passive mechanical components in closed cooling water systems are adequately managed without reliance on performance and functional testing.

**Operating Experience**

Refer to Section B.1.30.1 for the operating experience applicable to this program since the Closed Cooling Water Chemistry Control Program and the Auxiliary Systems Water Chemistry Control Program are implemented by the same procedures and site personnel.

**Conclusion**

ANO-2 chemistry activities manage loss of material and cracking for components in closed cooling water systems. These activities provide for monitoring and controlling closed cooling water chemistry using ANO-2 procedures and processes based on EPRI closed cooling water chemistry guidelines. The Closed Cooling Water Chemistry Control Program provides reasonable assurance that the effects of aging will be managed such that applicable components will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

## B.1.30.3 Primary and Secondary Water Chemistry Control

### Program Description

The Primary and Secondary Water Chemistry Control Program at ANO-2 is comparable to the program described in NUREG-1801, Section XI.M2, Water Chemistry.

For license renewal, the main objective of this program is to manage aging effects caused by corrosion and cracking mechanisms. The program relies on monitoring and control of water chemistry based on the EPRI guidelines in TR-105714 for primary water chemistry and TR-102134 for secondary water chemistry.

### NUREG-1801 Consistency

The Primary and Secondary Water Chemistry Control Program is consistent with the program described in NUREG-1801, Section XI.M2, Water Chemistry.

### Operating Experience

The ANO chemistry staff documents chemistry parameters that are out of specification with condition reports which demonstrate that periodic monitoring and control of contaminants is performed, thereby effectively managing aging effects. For example, a condenser tube leak was detected by a rapid rise in sodium concentrations, and the condition was corrected by repairs to leaking condenser tubes.

The ANO chemistry program was evaluated by the ANO QA staff in 2002. The audit team determined that there were specific areas where focused attention by management could improve program performance. However, the overall conclusion was that the ANO chemistry program is effective and achieving the intended results. The conclusion is borne out by recent trends of chemistry performance indicators.

The program procedures are the same as those used for ANO-1 chemistry programs. The ANO-1 program was reviewed by a NRC review team (0CNA040109, dated April 23, 2001) who found that the ANO staff was properly implementing the requirements of the program. The team examined the acceptance criteria identified by program procedures and concluded the requirements are implemented consistent with industry standards and guidelines, and trending results are periodically reviewed and evaluated.

### Conclusion

The Primary and Secondary Water Chemistry Control Program provides reasonable assurance that the effects of aging will be managed such that the applicable components will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

## B.2 REFERENCES

B.2-1 NUREG-1800, *Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants*, U.S. Nuclear Regulatory Commission, July 2001.

B.2-2 NUREG-1801, *Generic Aging Lessons Learned (GALL) Report,* U.S. Nuclear Regulatory Commission, July 2001.

B.2-3 NUREG-1743, *Safety Evaluation Report Related to the License Renewal of Arkansas Nuclear One, Unit 1*, U.S. Nuclear Regulatory Commission, April 2001.