APPENDIX B – AGING MANAGEMENT ACTIVITIES

INTRODUCTION

The aging management activity descriptions are provided in this appendix for each activity credited for managing aging effects based upon the aging management review results provided in Sections 3.1 through 3.6.

The FCS Quality Assurance Program implements the requirements of 10 CFR 50, Appendix B, and is consistent with the summary in Appendix A.2 of NUREG-1800. The Quality Assurance Program includes the elements of corrective action, confirmation process, and administrative controls, and is applicable to the safety-related and non-safety-related structures, systems, and components that are subject to aging management review.

In many cases, existing activities were found adequate for managing aging effects during the period of extended operation. In some cases, aging management reviews revealed that existing activities should be enhanced to adequately manage aging. In a few cases, new activities were developed to provide reasonable assurance that aging effects are adequately managed.

Each aging management activity presented in this appendix is characterized as one of the following:

Existing Activity: A current activity that will continue to be implemented during the period of extended operation.

Enhanced Activity: A current activity that will be modified to manage aging during the period of extended operation.

New Activity: An activity that does not currently exist, which will manage aging during the period of extended operation.

The following aging management activities are described in the sections listed in this appendix. Site specific programs are indicated. All other programs correlate to some degree with programs in NUREG-1801.

Existing Aging Management Activities

B.1.1 Bolting Integrity Program

B.1.2 Chemistry Program

B.1.3 Containment Inservice Inspection Program

B.1.4 Containment Leak Rate Program

B.1.5 Flow Accelerated Corrosion Program

B.1.6 Inservice Inspection Program

B.1.7 Reactor Vessel Integrity Program

Enhanced Aging Management Activities

B.2.1 Boric Acid Corrosion Prevention Program

B.2.2 Cooling Water Corrosion Program

B.2.3 Diesel Fuel Monitoring and Storage Program

B.2.4 Fatigue Monitoring Program

B.2.5 Fire Protection Program

B.2.6 Overhead Load Handling Systems Inspection Program

B.2.7 Periodic Surveillance and Preventive Maintenance Program **(site specific program)**

B.2.8 Reactor Vessel Internals Inspection Program

B.2.9 Steam Generator Program

B.2.10 Structures Monitoring Program

New Aging Management Activities

B.3.1 Alloy 600 Program

B.3.2 Buried Surfaces External Corrosion Program

B.3.3 General Corrosion of External Surfaces Program **(site specific program)**

B.3.4 Non-EQ Cable Aging Management Program **(site specific program)**

B.3.5 One-Time Inspection Program

B.3.6 Selective Leaching Program

B.3.7 Thermal Aging Embrittlement of Cast Austenitic Stainless Steel

Correlation between NUREG-1801 (Generic Aging Lessons Learned (GALL)) programs and FCS programs are shown below. For the FCS Programs, appropriate references to sections of this application are provided.

NUREG-1801 ID Number	NUREG-1801 Program	FCS Program
XI.M1	ASME Section XI Inservice Inspection, Subsection IWB, IWC, IWD	Inservice Inspection Program (B.1.6)
XI.M2	Water Chemistry	Chemistry Program (B.1.2)
XI.M3	Reactor Head Closure Studs	Bolting Integrity Program (B.1.1)
XI.M4	BWR Vessel ID Attachment Welds	Not applicable, FCS is a PWR.
XI.M5	BWR Feedwater Nozzle	Not applicable, FCS is a PWR.
XI.M6	BWR Control Rod Drive Return Line Nozzle	Not applicable, FCS is a PWR.
XI.M7	BWR Stress Corrosion Cracking	Not applicable, FCS is a PWR.
XI.M8	BWR Penetrations	Not applicable, FCS is a PWR.
XI.M9	BWR Vessel Internals	Not applicable, FCS is a PWR.
XI.M10	Boric Acid Corrosion	Boric Acid Corrosion Prevention Program (B.2.1)
XI.M11	Nickel-Alloy Nozzles and Penetrations	Alloy 600 Program (B.3.1)
XI.M12	Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)	Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) (B.3.7)
XI.M13	Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS)	Reactor Vessel Internals Inspection Program (B.2.8)
XI.M14	Loose Part Monitoring	Not credited for aging management. Reactor vessel internals inspections were determined to be adequate to manage identified aging effects.

NUREG-1801 ID Number	NUREG-1801 Program	FCS Program
XI.M15	Neutron Noise Monitoring	Reactor vessel internals vibration monitoring is a current FCS licensing commitment. The implementing task is incorporated in the Reactor Vessel Internals Inspection Program (B.2.8).
XI.M16	PWR Vessel Internals	Reactor Vessel Internals Inspection Program (B.2.8)
XI.M17	Flow-Accelerated Corrosion	Flow-Accelerated Corrosion Program (B.1.5)
XI.M18	Bolting Integrity	Bolting Integrity Program (B.1.1)
XI.M19	Steam Generator Tube Integrity	Steam Generator Program (B.2.9)
XI.M20	Open-Cycle Cooling Water System	Cooling Water Corrosion Program (B.2.2)
XI.M21	Closed-Cycle Cooling Water System	Cooling Water Corrosion Program (B.2.2)
XI.M22	Boraflex Monitoring	Not applicable, FCS does not have Boraflex.
XI.M23	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems	Overhead Loading Handling Systems Inspection Program (B.2.6)
XI.M24	Compressed Air Monitoring	Not credited for aging management. No aging effects requiring management were identified for the Compressed Air System.
XI.M25	BWR Reactor Water Cleanup System	Not applicable, FCS is a PWR.
XI.M26	Fire Protection	Fire Protection Program (B.2.5)
XI.M27	Fire Water System	Fire Protection Program (B.2.5)

NUREG-1801 ID Number	NUREG-1801 Program	FCS Program
XI.M28	Buried Piping and Tanks Surveillance	Not credited for aging management. FCS cathodic protection was not credited for managing aging effects. The FCS aging management program was based on the requirements of NUREG-1801 XI.M34.
XI.M29	Aboveground Carbon Steel Tanks	Not credited for aging management. Steel tanks were not treated as separate components from their respective systems. Applicable aging management activities have been incorporated into programs credited for similar component, material, and environments in the system.
XI.M30	Fuel Oil Chemistry	Diesel Fuel Monitoring and Storage Program (B.2.3)
XI.M31	Reactor Vessel Surveillance	Reactor Vessel Integrity Program (B.1.7)
XI.M32	One-Time Inspection	One-Time Inspection Program (B.3.5)
XI.M33	Selective Leaching of Materials	Selective Leaching Program (B.3.6)
XI.M34	Buried Piping and Tanks Inspection	Buried Surfaces External Corrosion Program (B.3.2)
XI.E1	Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements	Plant Specific Program - Non-EQ Cable Aging Management Program (B.3.4)
XI.E2	Electrical Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits	Plant Specific Program - Non-EQ Cable Aging Management Program (B.3.4)

NUREG-1801 ID Number	NUREG-1801 Program	FCS Program
XI.E3	Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements	Plant Specific Program - Non-EQ Cable Aging Management Program (B.3.4)
XI.S1	ASME Section XI, Subsection IWE	Containment Inservice Inspection Program (B.1.3)
XI.S2	ASME Section XI, Subsection IWL	Containment Inservice Inspection Program (B.1.3)
XI.S3	ASME Section XI, Subsection IWF	Inservice Inspection Program (B.1.6)
XI.S4	10 CFR 50, Appendix J	Containment Leak Rate Program (B.1.4)
XI.S5	Masonry Wall Program	Structures Monitoring Program (B.2.10)
XI.S6	Structures Monitoring Program	Structures Monitoring Program (B.2.10)
XI.S7	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	Structures Monitoring Program (B.2.10)
XI.S8	Protective Coating Monitoring and Maintenance Program	Not credited for aging management.
Chapter 10		
X.M1	Metal Fatigue of Reactor Coolant Pressure Boundary	Fatigue Monitoring Program (B.2.4)
X.E1	Environmental Qualification (EQ) of Electric Components	See Section 4.4 of this application.
X.S1	Concrete Containment Tendon Prestress	Containment Inservice Inspection Program (B.1.3)

B.1 EXISTING AGING MANAGEMENT ACTIVITIES

B.1.1 BOLTING INTEGRITY PROGRAM

The Bolting Integrity Program is consistent with XI.M3, "*Reactor Head Closure Studs*" and XI.M18, "*Bolting Integrity*," as identified in NUREG-1801 with the following exception:

- § XI.M18 - 3. Parameters Monitored/Inspected and 4. Detection of Aging Effects

  FCS has not identified stress corrosion cracking (SCC) as a creditable aging effect requiring management for high strength carbon steel bolting in plant indoor air. FCS will utilize ASME Section XI, Subsection IWF visual VT-3 inspection requirements rather than volumetric inspections for inspection of supports.

The scope of the FCS Bolting Integrity Program includes those plant specific components identified in Tables 3.1.2 and 3.5.2 of this application for which the Bolting Integrity Program is identified as an aging management program.

Operating Experience:

Inspections of bolted components have been conducted under the FCS Inservice Inspection Program (based on ASME Section XI code requirements), the FCS Boric Acid Corrosion (BAC) Prevention Program, and the Structures Monitoring Program. Visual inspections conducted under the Boric Acid Corrosion Prevention Program include inspection of bolted components in borated systems. Any indication of BAC residue or damage is reported and evaluated to determine if a component can remain in service per established procedures. Documentation of operating experience is included in the BAC Inspection Program. On occasion, visual observations have identified BAC damage. These deficiencies were documented in accordance with the FCS corrective action program and resulted in repair or replacement if required. Review of the plant specific operating experience indicates that the inspections have been effective in managing the aging effects of bolted components.

Conclusion:

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

B.1.2 CHEMISTRY PROGRAM

The FCS Chemistry Program is consistent with XI.M2, *Water Chemistry*, and the chemistry-related portions of XI.M21, *Closed-Cycle Cooling Water System*, as identified in NUREG-1801. The scope of the FCS Chemistry Program includes those plant specific components identified in Tables 3.1.2 through 3.5.2 and Tables 3.1.3 through 3.5.3 of this application for which the Chemistry Program is identified as an aging management program.

Operating Experience:

Over the FCS operating history, chemistry related situations have occasionally occurred. These include a steam generator tube leak, condenser tube leaks, and some resin intrusion into the primary water storage tank. These situations were properly corrected and long-term corrective actions were implemented to prevent recurrence. Chemistry management of aging effects has evolved over the years based on FCS and industry experience. OPPD has adopted industry practices throughout the years, and continues to do so in order to enhance chemistry control. The low percentage of plugged steam generator tubes based on the number of years the generators have been in service is indicative of the effective chemistry control. The overall experience illustrates that the Chemistry Program is effective in managing aging.

Conclusion:

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

B.1.3 CONTAINMENT INSERVICE INSPECTION PROGRAM

The FCS Containment Inservice Inspection Program is consistent with X.S1, "*Concrete Containment Tendon Prestress*," XI.S1, "*ASME Section XI, Subsection IWE*," and XI.S2, "*ASME Section XI, Subsection IWL*," as identified in NUREG-1801. The 10 Year Containment (IWE & IWL) Inservice Inspection Program Plan for FCS, incorporating Subsection IWE and Subsection IWL examination requirements, has been developed and implemented.

Operating Experience:

Inspections of the Containment Liner have been conducted in accordance with the Containment Leak Rate Testing Program and the Maintenance Rule Implementation Program. Inspections of the tendons and tendon anchorages have been conducted in accordance with Technical Specifications, the USAR, and plant procedures. The ASME Section XI, Subsection IWL Inservice Inspection Program incorporates all of the inspection criteria and guidelines of the previous tendon inspection program and is implemented using existing plant procedures. No significant age related degradation has been identified in theinspections performed.

Conclusion:

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

B.1.4 CONTAINMENT LEAK RATE PROGRAM

The FCS Containment Leak Rate Program is consistent with XI.S4, "*10 CFR Part 50, Appendix J*," and applicable sections of XI.S1, "*ASME XI, Subsection IWE"* related to Appendix J testing as identified in NUREG-1801.

Operating Experience:

Containment leak-tight verification and visual examination of the steel components that are part of the leak-tight barrier have been conducted at FCS since initial unit startup. Prior to the development of the ASME Section XI, Subsection IWE Inservice Inspection Program, examinations were performed in accordance with 10 CFR 50, Appendix J. No significant age related degradation has been identified in the inspections performed.

Conclusion:

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

B.1.5 FLOW ACCELERATED CORROSION PROGRAM

The FCS Flow Accelerated Corrosion (FAC) Program is consistent with XI.M17, "*Flow-Accelerated Corrosion*," as identified in NUREG-1801. The scope of the FCS FAC Program includes those plant specific components identified in Tables 3.1.3 and 3.4.3 of this application for which the FAC Program is identified as an aging management program.

Operating Experience:

FAC inspections have been performed periodically on both in-scope and out-of-scope piping. These inspections have gone on for many years and the FAC program has been adjusted based on inspection and other results. On occasion, pipe wall has been found below established screening criteria and visual observations have identified through-wall erosion. These deficiencies were documented in accordance with the FCS corrective action program and resulted in repair or replacement of the affected areas. A rupture occurred on a non-CQE extraction steam line in 1997 which resulted in significant upgrades to the FAC program. Internal audits and NRC inspection of the program since 1997 have found the program to be maintained in accordance with NSAC-202L-R2, "*Recommendations for an Effective Flow-Accelerated Corrosion Program*."

Conclusion:

The Flow Accelerated Corrosion Program provides reasonable assurance that flow accelerated corrosion will be managed such that components subject to aging management review will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.1.6 INSERVICE INSPECTION PROGRAM

The Inservice Inspection Program is consistent with XI.M1, "*ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD*," and XI.S3, "*ASME Section XI, Subsections IWF*," as identified in NUREG-1801. The scope of the FCS Inservice Inspection Program includes those plant specific components identified in Tables 3.1.2 and 3.1.3 of this application for which the Inservice Inspection Program is identified as an aging management program.

Operating Experience:

Review of the plant specific operating experience indicates that the FCS Inservice Inspection Program has been effective in managing the aging effects of components. No significant age related deterioration has been identified in the inspections performed.

Conclusion:

The FCS Inservice Inspection Program provides reasonable assurance that the aging effects will be managed such that the ASME Class 1, 2, and 3 components and their integral supports subject to aging management review will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.1.7 REACTOR VESSEL INTEGRITY PROGRAM

The FCS Reactor Vessel Integrity Program is consistent with XI.31, "*Reactor Vessel Surveillance*," as identified in NUREG-1801 with the exception of the following enhancements that will be made to the Reactor Vessel Integrity Program prior to the period of extended operation.

NUREG-1801 Program	Criteria	Enhancement
XI.31, Reactor Vessel Surveillance	Evaluation and Technical Basis Reactor vessel surveillance programs are plant specific, depending on matters such as the composition of limiting materials, availability of surveillance capsules, and projected fluence levels. In accordance with 10 CFR Part 50, Appendix H, an applicant submits its proposed withdrawal schedule for approval prior to implementation. Thus, further staff evaluation is required for license renewal.	The revised, optimized withdrawal and test schedule was submitted to the NRC staff for review and approval per OPPD Letter LIC-01-0107 dated November 8, 2001.

Operating Experience:

At FCS, three surveillance capsules have been removed and the materials tested. The FCS operating experience is being supplemented by surveillance capsule test results from other operating reactors whose surveillance capsules include materials that exactly match the materials of the various FCS reactor vessel beltline welds, including the limiting or critical weld. The results of testing of the early surveillance capsules, use of the chemistry factors for the limiting weld, and the early results of the updated fluence analysis indicated that the FCS reactor vessel could exceed the PTS screening criteria of 10 CFR 50.61 before the end of the current 40-year license period in 2013. As a result, FCS implemented core design limitations aimed at restricting the fluence of the reactor vessel beltline region. Analysis has been completed which demonstrates that FCS will be able to operate to the end of the extended period of operation without exceeding the PTS screening criteria. These analysis results have been reviewed and NRC approved by Amendment 199 to the FCS Operating License.

Conclusion:

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

B.2 ENHANCED AGING MANAGEMENT ACTIVITIES

B.2.1 BORIC ACID CORROSION PREVENTION PROGRAM

The FCS Boric Acid Corrosion (BAC) Prevention Program is consistent with XI.M10, "*Boric Acid Corrosion*," as identified in NUREG-1801 with the exception of enhancements specified in the following table. These enhancements will be made to the Boric Acid Corrosion Program prior to the period of extended operation. The scope of the FCS Boric Acid Corrosion Program includes those plant specific components identified in Tables 3.1.2, 3.1.3, and 3.3.3 of this application for which the Boric Acid Corrosion Program is identified as an aging management program.

NUREG-1801 Program	Criteria	Enhancement
XI.M10 Boric Acid Corrosion	Scope	Specific guidance will be added to the program basis document and applicable procedures to inspect components, structures, and electrical components where boric acid may have leaked. Add Spent Fuel Pool Cooling and Waste Disposal Systems to the program.
	Parameters Monitored/ Inspected	Two areas not routinely inspected will be added to inspection scope.
	Monitoring and Trending	Specific guidance will be implemented for maintenance personnel to report boric acid leakage to the BAC Program Engineer.

Operating Experience:

FCS experienced severe boric acid corrosion on reactor coolant pump studs as documented in NRC Generic Letter (GL) 88-05, "*Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants*." Significant program improvements were implemented in response to that GL. A review of the post GL 88-05 operating history indicates that the BAC Prevention Program at FCS routinely identifies and corrects borated water leakage and BAC in the Reactor Coolant System and other borated water systems, including any adjacent structures or components that could be adversely affected.

Conclusion:

The FCS Boric Acid Corrosion Prevention Program provides reasonable assurance that the aging effects will be managed such that the susceptible components subject to aging management review will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.2 COOLING WATER CORROSION PROGRAM

The FCS Cooling Water Corrosion Program is consistent with XI.M20, "*Open-Cycle Cooling Water System*," and XI.21, "*Closed-Cycle Cooling Water System*," as identified in NUREG-1801, with the exception of the enhancements specified in the following table and with the following clarifications:

- XI.M20 - Program Description, 3. Parameters Monitored/Inspected, 4.Detection of Aging Effects, 5. Monitoring and Trending, and 6. Acceptance Criteria

  External coatings are addressed by the FCS General Corrosion of External Surfaces Program.

- XI.M21 - Program Description, 2. Preventative Actions, 5. Monitoring and Trending, 6. Acceptance Criteria, and 7. Corrective Action

  The Chemistry-related portions of the program are addressed in the FCS Chemistry Program.

- The scope of the FCS Cooling Water Corrosion Program includes those plant specific components identified in Tables 3.2.2, 3.3.2, and 3.3.3 of this application for which the Cooling Water Corrosion Program is identified as an aging management program.

The FCS Cooling Water Corrosion Program will also include the following exceptions to NUREG-1801:

- XI.M21 - 3. Parameters Monitored/Inspected, 4. Detection of Aging Effects, and 5. Monitoring and Trending

  The license renewal commitment for these programs relates only to the maintenance of the pressure boundary and not the maintenance of fluid flow. Fluid flow is considered an active function. Performance testing and other active system function testing is not performed on an 18 month or 5 year frequency in accordance with EPRI TR-107396, Closed Cooling Water Chemistry Guideline, because this EPRI document does not address this criteria or specify that testing frequency. Non-destructive testing and heat transfer performance to identify pressure boundary integrity are performed per EPRI TR-107396.

The following enhancements will be made to the Cooling Water Corrosion Program prior to the period of extended operation.

NUREG-1801 Program	Criteria	Enhancement
XI.M20, Open-Cycle Cooling Water System	1. Scope of Program 4. Detection of Aging Effects 5. Monitoring and Trending	Inspections to various raw water components will be added based on FCS' Cooling Water Corrosion Program susceptibility evaluation. These inspection activities will be commensurate with the GALL Program.
XI.M21, Closed-Cycle Cooling Water System	3. Parameters Monitored/ Inspected 4. Detection of Aging Effects	Inspections to various cooling water components will be added based on FCS' Cooling Water Corrosion Program susceptibility evaluation. These inspection activities will be commensurate with the GALL Program.

Operating Experience:

Review of FCS operating experience has identified some component part replacements (and repairs) due to corrosion and cracking in the Component Cooling Water and Raw Water Systems. Appropriate long term corrective actions were implemented based on these experiences. These included material changes, additional preventive maintenance, and increased sample evaluation.

Conclusion:

The FCS Cooling Water Corrosion Program provides reasonable assurance that the aging effects will be managed such that the components subject to aging management review will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.3 DIESEL FUEL MONITORING AND STORAGE PROGRAM

The FCS Diesel Fuel Monitoring and Storage Program is consistent with XI.M30, "*Fuel Oil Chemistry*," as identified in NUREG-1801 with the exception of the enhancements specified in the following table, and with the following clarifications:

- XI.M30-3. Parameters Monitored/Inspected

  Although OPPD does perform particulate analysis of fuel oil, OPPD does not credit this analysis for any aging management. Particulate analysis is performed on diesel fuel for fuel burn quality concerns (i.e., clogging of filters), and does not have any impact on pressure boundary integrity.

- XI.M30-4. Detection of Aging Effects

  Ultrasonic testing is not performed on the fire protection diesel fuel oil tank due to the inaccessibility of the tank. Leak detection is employed to monitor the condition of the tank and is adequate to maintain the system design requirements.

- The scope of the FCS Diesel Fuel Monitoring and Storage Program includes those plant specific components identified in Tables 3.3.2 and 3.3.3 of this application for which the Diesel Fuel Monitoring and Storage Program is identified as an aging management program.

The following enhancements will be made to the Diesel Fuel Monitoring and Storage Program prior to the period of extended operation.

NUREG-1801 Program	Criteria	Enhancement
XI.M30, Fuel Oil Chemistry	2. Preventive Actions	Removal of sediment and water at the bottom of the Fire Protection diesel fuel tank will be added.
	4. Detection of Aging Effects	Inspection of diesel fuel day tanks for corrosion will be added.
	5. Monitoring and Trending	Fuel analysis of the Fire Protection Day Tank will be added.

Operating Experience:

FCS operating experience indicates there have been no instances of fuel oil system component failures due to aging effects.

Conclusion:

The FCS Diesel Fuel Monitoring and Storage Program provides reasonable assurance that the aging effects will be managed such that the components subject to aging management review will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.4 FATIGUE MONITORING PROGRAM

The FCS Fatigue Monitoring Program is consistent with X.M1, "*Metal Fatigue of Reactor Coolant Pressure Boundary*," as identified in NUREG-1801 with the exception of the enhancements specified in the following table. These enhancements will be made to the Fatigue Monitoring Program prior to the period of extended operation. The scope of the FCS Fatigue Monitoring Program includes those plant specific components identified in Table 3.1.2 of this application for which the Fatigue Monitoring Program is identified as an aging management program.

NUREG-1801 Program	Criteria	Enhancement
X.M1, Metal Fatigue of Reactor Coolant Pressure Boundary	1. Scope	Add the following to the scope of components subject to the FCS Fatigue Monitoring Program: • Pressurizer Surge Line bounding locations • Class 2 and 3 components not included in the NUREG-1801 program which are subject to fatigue as an aging effect requiring management.
	2. Preventive Actions 6. Acceptance Criteria	Perform site-specific analysis to address environmental fatigue concerns identified in NUREG/CR-6260. Corrective actions or program enhancements will be implemented if necessary based on the results of evaluation.

Operating Experience:

There have been no thermal fatigue related failures at FCS; however, there have been two occurrences (with associated corrective action documents) at FCS relative to thermal fatigue that have resulted in enhancements to the FCS Fatigue Monitoring Program.

The first of these documents summarizes concerns about the operation of the Chemical and Volume Control System (CVCS) and whether specific components within or related to the system were having their thermal cycles monitored and tracked consistently. This resulted in the performance of an Engineering Assessment to document a review of Design Basis Documents, the USAR, Technical Specifications, and other documents to determine cycle counting requirements. This review resulted in revision to some of these documents. An

operating history review was performed to determine the number of cycles that the components of concern actually experienced. Part of this review was to ensure that the thermal cycles counted were, in fact, a result of design basis conditions that merited inclusion in the cycle counting.

The other document was written after a rash of industry small bore piping failures (generally detected as small cracks or leaks as opposed to major pressure boundary ruptures) in primary coolant systems. Two of the resulting action items created a small bore piping fatigue program and a systematic program for thermal fatigue. These actions have been ongoing and are being integrated with license renewal specific thermal fatigue action items to form the basis for this new program.

The sample frequency of the Primary Sampling System is such that its limit of 7000 cycles will be exceeded before the end of the period of extended operation. Prior to entering the period of extended operation, a stress analysis will be performed based on the sampling evolution parameters to determine whether or not the applicable sampling evolution piping will have to be replaced before the end of the period of extended operation.

Pressurizer surge line thermal stratification is an issue identified by NRC Bulletin 88-11. Generic and bounding analysis for all CE plants was performed by CE and submitted to the NRC. The fatigue portion of this analysis calculated a 0.937 usage factor for the surge line after the 40-year design life that would obviously be exceeded during the period of extended operation. This value is based on the use of the most limiting configuration of the surge line that exists in the CE-designed plants and as a result is very conservative for FCS. To address this issue for the purposes of license renewal, the pressurizer surge line bounding locations will be included in the FCS Fatigue Monitoring Program. As part of this program, realistic usage factors will be compiled for the critical areas based on actual plant operating data to include the effects of thermal stratification. These are expected to be lower than those predicted by the generic evaluation. This reevaluation will take place prior to the period of extended operation. Based on the results of this plant specific analysis, realistic fatigue usage for the surge line will be tracked, and actions will be taken to reevaluate, repair, or replace the surge line as necessary.

Conclusion:

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

B.2.5 FIRE PROTECTION PROGRAM

The Fire Protection Program is consistent with XI.M26, "*Fire Protectio*n," and XI.M27, *"Fire Water Syste*m," as identified in NUREG-1801 with the exception of the enhancements specified in the following table and with the following clarification:

- XI.M27-2. Preventative Action

  NUREG-1801 specifies in Section XI.M27, "*Fire Water Syste*m," that "portions of the fire protection sprinkler system, which are not routinely subjected to flow, are to be subjected to full flow tests at the maximum design flow and pressure." The FCS USAR, Table 9.11-3, directs flow testing to be performed using a clean water source. The demineralized water booster pumps or Blair City water are used for flow testing at pressures slightly lower than the normal system operating pressure. This is not consistent with NUREG-1801; however, both the pressure and resulting flow are sufficient to effectively entrain and adequately flow test/flush the sprinkler system piping. This ensures that aging effects are managed such that the intended function is maintained.

The following enhancements will be made to the Fire Protection Program prior to the period of extended operation. The scope of the FCS Fire Protection Program includes those plant specific components identified in Table 3.3.2 of this application for which the Fire Protection Program is identified as an aging management program.

NUREG-1801 Program	Criteria	Enhancement
XI.M26, *Fire Protection*	3. Parameters Monitored or Inspected	Additional guidance will be added to the diesel fire pump maintenance procedure to inspect diesel fire pump fuel line and zinc plug for corrosion or mechanical damage. Specific guidance will be added to halon and fire damper inspection procedures to inspect halon system components and fire dampers for corrosion, mechanical, and physical damage. Specific acceptance criteria will be added to fire barrier inspection procedures for concrete walls, floors, and ceilings. Specific guidance will be added to the fire door inspection procedure to inspect for wear and missing parts.
XI.M27, *Fire Water System*	Program Description	Specific guidance will be developed to replace or inspect in-scope sprinkler heads in accordance with NFPA 25
	2. Preventive Actions	Additional guidance will be added to one of the system valve cycling tests to improve system flushing.
	3. Parameters Monitored or Inspected	Specific guidance will be developed for flow testing in-scope sprinkler system.

Operating Experience:

Routine visual inspections of fire barriers have proven effective in identifying material degradation and damage. A recent decline in the number of identified fire barrier penetration discrepancies is attributed to a recent fire barrier and penetration upgrade effort. Historical operating experience shows fire barrier walls, ceilings, doors and floors are adequately managed through inspections.

Through-wall leakage of seamed fire protection system piping has been identified at FCS. Routine walkdowns and piping inspections (internal inspections performed when the system is breached for repair) have been implemented to accurately detect and identify early stages of pressure boundary deterioration and leakage. Historical operating experience and discussions with fire protection personnel show this program effectively manages and corrects pressure boundary failures. Operating history for yard fire hydrants, fire dampers, sprinklers and nozzles shows adequate management of the aging effects identified by chapters XI.M26 and XI.M27 of NUREG-1801. Halon system piping and tanks have shown few historical discrepancies and are adequately managed by the FCS program. No historical experience was identified concerning the diesel fire pump fuel oil supply line.

Conclusion:

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

B.2.6 OVERHEAD LOAD HANDLING SYSTEMS INSPECTION PROGRAM

The FCS Overhead Load Handling Systems Inspection Program is consistent with XI.M23, "*Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling System*s," as identified in NUREG-1801 with the exception of the enhancements specified in the following table. The following enhancements will be made to the Overhead Load Handling Systems Inspection Program prior to the period of extended operation.

NUREG-1801 Program	Criteria	Enhancement
XI.M23, *Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling System*s	5. Detection of Aging Effects	Specific guidance will be added to applicable inspection procedures to inspect for degradation of expansion anchors and surrounding concrete.
	6. Acceptance Criteria	Specific guidance will be added to applicable inspection procedures to identify acceptance criteria for general corrosion and degradation of expansion anchors and surrounding concrete.
	7. Corrective Actions	Specific guidance will be added to applicable inspection procedures to initiate FCS corrective action documentation if excessive general corrosion or cracking of concrete around expansion anchors is identified.

Operating Experience:

The subject load handling equipment is periodically inspected for degradation. No aging effects which impact the intended functions of the structures or components were identified in the inspections performed.

Conclusion:

The FCS Overhead Load Handling Systems Inspection Program provides reasonable assurance that aging effects will be managed such that the components subject to aging management review will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.7 PERIODIC SURVEILLANCE AND PREVENTIVE MAINTENANCE (PM) PROGRAM

The stated purpose of the PM program is to prevent or minimize equipment breakdown and to maintain equipment in a condition that will enable it to perform its normal and emergency functions. The program and the site administrative control processes provide for a systematic approach in establishing the method, frequency, acceptance criteria, and documentation of results.

The FCS Periodic Surveillance and Preventive Maintenance Program consists of periodic inspections and tests that are relied on to manage aging for system and structural components and that are not evaluated as part of the other aging management programs addressed in this appendix. The preventive maintenance and surveillance testing activities are implemented through periodic work orders that provide for assurance of functionality of the components by confirmation of integrity of applicable parameters.

EVALUATION AND TECHNICAL BASIS

(1) Scope of Program:

The FCS Periodic Surveillance and Preventive Maintenance Program provides for periodic inspection and testing of components in the following systems and structures.

- Auxiliary Building
- Auxiliary Building HVAC
- Auxiliary Feedwater
- Chemical and Volume Control
- Component Cooling
- Containment
- Containment HVAC
- Control Room HVAC and Toxic Gas Monitoring
- Diesel Generator Lube Oil
- Duct Banks
- Emergency Diesel Generators
- Fire Protection
- Fuel Handling Equipment/Heavy Load Cranes
- Intake Structure
- Liquid Waste Disposal
- Containment Penetration, and System Interface Components for Non-CQE Systems
- Reactor Coolant
- Safety Injection and Containment Spray
- Ventilating Air

(2) Preventive Actions:

The Periodic Surveillance and Preventive Maintenance Program includes periodic refurbishment or replacement of components, which could be considered to be preventive or mitigative actions. The inspections and testing to identify component aging degradation effects do not constitute preventive actions in the context of this element.

(3) Parameters Monitored or Inspected:

Inspection and testing activities monitor parameters including surface condition, loss of material, presence of corrosion products, signs of cracking and presence of water in oil samples.

(4) Detection of Aging Effects:

Preventive maintenance and surveillance testing activities provide for periodic component inspections and testing to detect the following aging effects and mechanisms:

- Change in Material Properties
- Cracking
- Fouling
- Loss of Material
- Loss of Material - Crevice Corrosion
- Loss of Material - Fretting
- Loss of Material - General Corrosion
- Loss of Material - Pitting Corrosion
- Loss of Material - Pitting/ Crevice/Gen. Corrosion
- Loss of Material - Wear
- Separation

The extent and schedule of the inspections and testing assures detection of component degradation prior to the loss of their intended functions. Established techniques such as visual inspections and dye penetrant testing are used.

(5) Monitoring and Trending:

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

The program includes provisions for monitoring and trending with the stated intent of identifying potential failures or degradation and making adjustments to ensure components

remain capable of performing their functions. PM review and update guidelines are provided that include adjustment of PM task and frequency based on the as-found results of previous performance of the PM. In particular, responsible system engineers are required to periodically review the results of preventive maintenance and recommend changes based on these reviews. The program includes guidance to assist the system engineers in achieving efficient and effective trending.

(6) Acceptance Criteria:

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

(7) Corrective Actions:

Identified deviations are evaluated within the FCS corrective action process, which includes provisions for root cause determinations and corrective actions to prevent recurrence as dictated by the significance of the deviation. The FCS corrective action process is in accordance with 10 CFR 50 Appendix B.

(8) Confirmation Process:

The FCS corrective action process is in accordance with 10 CFR 50 Appendix B and includes:

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

(9) Administrative Controls:

All credited aging management activities are subject to the FCS administrative controls process, which is in accordance with 10 CFR 50 Appendix B and requires formal reviews and approvals.

(10) Operating Experience:

Periodic surveillance and preventive maintenance activities have been in place at FCS since the plant began operation. These activities have a demonstrated history of detecting damaged and degraded components and causing their repair or replacement in accordance with the site corrective action process. With few exceptions, age-related degradation adverse to component intended functions was discovered and corrective actions were taken prior to loss of intended function.

Conclusion:

The Periodic Surveillance and Preventive Maintenance Program assures that various aging effects are managed for a wide range of components at FCS. Based on the program structure and administrative processes and FCS operating experience, there is reasonable assurance that the credited inspection and testing activities of the Periodic Surveillance and Preventive Maintenance Program will continue to adequately manage the identified aging effects of the applicable components so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation.

B.2.8 REACTOR VESSEL INTERNALS INSPECTION PROGRAM

The FCS Reactor Vessel Internals Inspection Program is consistent with XI.M13, "*Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS)*," and XI.M16, "*PWR Vessel Internals*," as identified in NUREG-1801 with the exception of the enhancements specified in the following table and with the following exceptions:

- XI.M16-4. Detection of Aging Effects

  No augmented inspection of bolting is scheduled. The tensile stresses on the FCS reactor vessel internals bolting are lower than the industry levels where cracking was observed as an aging effect. Refer to discussion in Operating Experience below.

- XI.M16-Program Description, 1. Scope of Program and 2. Preventative Actions

  The Chemistry-related portions of the program are addressed in the FCS Chemistry Program.

The following enhancements will be made to the Reactor Vessel Internals Inspection Program prior to the period of extended operation. The scope of the FCS Reactor Vessel Internals Inspection Program includes those plant specific components identified in Tables 3.1.2 and 3.1.3 of this application for which the Reactor Vessel Internals Inspection Program is identified as an aging management program.

NUREG-1801 Program	Criteria	Enhancement
XI.M13, *Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS*)	4. Detection of Aging Effects	A fluence and stress analysis will be performed to identify critical locations. A fracture mechanics analysis for critical locations will be performed to determine flaw acceptance criteria and resolution required to detect flaws. Appropriate inspection techniques will be implemented based on analyses.
XI.M16, *PWR Vessel Internal*s	7. Parameters Monitored 8. Detection of Aging Effects	A fluence and stress analysis will be performed to identify critical locations. A fracture mechanics analysis for critical locations will be performed to determine flaw acceptance criteria and resolution required to detect flaws. Appropriate inspection techniques will be implemented based on analyses.

Operating Experience:

No cracking has been discovered in US pressurized water reactor (PWR) reactor vessel (RV) internals fabricated with austenitic stainless steel except for various bolting applications for Babcock & Wilcox and Westinghouse-designed NSSSs and thermal shield components at St. Lucie Unit 1 and Millstone Unit 2, which are CE designed Nuclear Steam Supply System (NSSS). The cracking at St. Lucie and Millstone was caused by flow-induced high cycle fatigue; the thermal shields at these plants were removed. Cracking of core barrel, baffle, and former bolts at Electricite de France (EdF), Westinghouse and Babcock & Wilcox-designed RV internals has been discovered. The cause of cracking of core barrel bolts at Babcock & Wilcox designed plants was stress corrosion cracking (SCC) and the cracking of baffle bolts at Westinghouse and EdF plants is believed to be irradiation assisted stress corrosion cracking (IASCC).

Reactor vessel internals inspections are performed under the FCS Inservice Inspection Program. No cracking caused by high cycle fatigue was discovered in the FCS thermal shield and therefore the FCS thermal shield was not removed, as is the case for St. Lucie Unit 1 and Millstone Unit 2. In 1984 a commitment was made to the NRC to perform an inspection of the thermal shield during the 1987 refueling outage. However, in 1986 an inspection deferral program was implemented that allowed a thermal shield monitoring program to replace the inspection commitment. This monitoring program generated data from 1988 through 1990 that indicated the early stages of loosening of the thermal sleeve positioning pins. During the 1992 refueling outage, visual inspection of the support lugs and the positioning pins was performed. No noticeable cracks, weld cracks, missing parts, misalignment, gaps, looseness, or wear were found. Eleven pins (7 lower pins and 4 upper pins) were removed and replaced to reinstate the specified amount of initial relative displacement between the thermal shield and the core support barrel. The amount of initial relative displacement was based on maintaining specified preload over twenty years in the pins while accounting for radiation-induced relaxation and wear. This action reduced vibrations to below specified levels. No unacceptable vibration has been detected since 1992 and FCS continues to monitor thermal shield vibrations using the Internals Vibration Monitoring program. Any unacceptable vibration will be corrected when appropriate.

To date, no cracking has been discovered in bolting for Combustion Engineering (CE)-designed RV internals bolting. The Combustion Engineering Owners Group (CEOG) provided an assessment of the cracking of the baffle former bolts reported in foreign PWRs, including the potential impact of the cracking on domestic CE plants. The results are in CEOG Report CE NPSD-1098 for CEOG Task 1011, "*Evaluation of the Applicability of Baffle Bolt Cracking to Ft. Calhoun and Palisades Internals Bolts*," Final Report, Revision 00, April 1998. The most likely mechanism for the cracking of cold-worked 316 stainless steel baffle former bolts in foreign plants is IASCC. There are only two CE-designed plants (FCS and Palisades) that use bolts to attach the core shroud panels (i.e., the baffle plates) to the former plates. The report indicates that these bolts in FCS are less susceptible to IASCC because: (1) the material used in these bolts is annealed 316 stainless steel, which is not cold worked; (2) the bolt stress from preload, as a percentage of yield strength, is much less than the EdF plants; (3) the differential pressure across the core shroud panels does not result in tensile loads on the panel (i.e., the baffle bolts) during normal operation; and (4) the core shroud

panel design allows for some flexing of the former plate relative to the core barrel, thus reducing the load on the panel bolts. Since CE NPSD-1098 was issued, cracking has been discovered in Point Beach baffle bolts. However, as with the EdF experience, cracked bolts were highly stressed during preload, tensile stresses were applied during operation because of the Westinghouse design, and the bolts were fabricated with cold worked 316 stainless steel. Therefore, the findings of CE NPSD-1098 still apply.

Stress corrosion cracking was identified in B&W lower thermal shield and lower core barrel bolts that were fabricated with A-286. Most of the failed bolts were highly stressed to at or over the yield strength. Cracked bolts were replaced with bolts of improved design fabricated with Inconel X-750. No cracking of these bolts has recurred. Although there have been no failures of CEA Shroud Bolts in CE-designed RV internals, there is a concern that SCC may occur since these bolts are fabricated with Alloy A-286. CE provided an evaluation of the stress level for these bolts in 1984. According to CEN-282, "*Investigation and Evaluation of A286 Bolt Applications in C-E's NSSS*," September 1984, operating stress levels are just below 32 Ksi. The stress concentration factor for the CEA Shroud Bolts is 2.06, leading to a local stress of approximately 66 Ksi. Yield strength for A-286 is about 115 Ksi, so the stress is approximately 60 percent of yield. Most of the failed B&W bolts had working stresses of approximately 65 Ksi and a local stress of 134 Ksi which is above the yield strength of the material. There were no failed B&W bolts with working stresses of 35 Ksi. The conclusion of the report indicates a low probability for cracking of the CEA Shroud Bolts.

Conclusion:

The Reactor Vessel Internals Inspection Program provides reasonable assurance that the aging effects will be managed such that the components subject to aging management review will continue to perform their intended function consistent with the current licensing basis for the period of extended operation.

B.2.9 STEAM GENERATOR PROGRAM

The FCS Steam Generator Program is consistent with XI.M19, "*Steam Generator Tube Integrity*," as identified in NUREG-1801 with the exception of the enhancements specified in the following table and with the following clarifications:

- In addition to the requirements of XI.M19, the FCS Steam Generator Program also includes aging management activities to address plant specific AMP requirements identified in Table 3.1.1.

- The scope of the FCS Steam Generator Program includes those plant specific components identified in Tables 3.1.2 of this application for which the Steam Generator Program is identified as an aging management program.

The following enhancements will be made to the Steam Generator Program prior to the period of extended operation.

NUREG-1801 Program	Criteria	Enhancement
XI.M19, Steam Generator Tube Integrity	2. Preventive Actions 6. Acceptance Criteria	An Annunciator Response Procedure will be written for the Loose Parts Monitor in the Steam Generator.

Operating Experience:

Steam generator management of aging effects has evolved and improved over the years based on industry experience. FCS has adopted industry practices throughout the years, and continues to do so. Past NRC inspections on this program cited sample plans and inspection evaluation as a strength. Only one noteworthy situation has occurred. In 1984, a misplug and misdiagnosed tube problem led to a tube rupture. This situation was corrected and long-term corrective actions were implemented to prevent recurrence. Current FCS practices are state-of-the-art. The overall experience illustrates that the Steam Generator Program is effective in managing aging.

Conclusion:

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

B.2.10 STRUCTURES MONITORING PROGRAM

The Structures Monitoring Program is consistent with XI.S5, *Masonry Wall Progra*m, XI.S6, "*Structures Monitoring Progra*m," and XI.S7, RG 1.127, *"Inspection of Water-Control Structures Associated with Nuclear Power Plant*s," as identified in NUREG-1801 with the exception of the enhancements specified in the following table and with the following clarifications:

- FCS does not have lubrite supports as identified in NUREG-1801, Chapter III, item A4.2-b. FCS does have lubrite on some steam generator supports which are inspected under the FCS Inservice Inspection Program rather than the Structures Monitoring Program.

- XI.S7. Program Description

  FCS is not committed to RG 1.127. Applicable attributes from RG 1.127 have been incorporated into the Structures Monitoring Program as specified in the program description.

The following enhancements will be made to the Structures Monitoring Program prior to the period of extended operation. The scope of the FCS Structures Monitoring Program includes those plant specific components identified in Tables 3.3.2, 3.5.2, and 3.5.3 of this application for which the Structures Monitoring Program is identified as an aging management program.

NUREG-1801 Program	10 elements	Enhancement
XI.S5, Masonry Wall Program	3. Parameters Monitored or Inspected	Specific guidance will be added to inspect masonry walls for cracking and condition of steel bracing.
	6. Acceptance Criteria	Specific acceptance criteria will be added to inspection procedures to be commensurate with industry codes, standards, and guidelines.

XI.S6, Structures Monitoring Program	3. Parameters Monitored or Inspected	Specific guidance will be added for inspection of component supports, new fuel storage rack, and the plant specific components identified in the Section 3 tables. Aging management activities related to these components will be commensurate with industry standards and practices as identified in the NUREG-1801 Structures Monitoring Program criteria.
	4. Detection of Aging Effects	Additional guidance commensurate with industry codes, standards, and guidelines, will be added to inspection procedures.
	6. Acceptance Criteria	Specific acceptance criteria will be added to the inspection procedures to be commensurate with industry codes, standards, and guidelines.
XI.S7, Regulatory Guide 1.127, Inspection of Water Control Structures Associated with Nuclear Power Plants	3. Parameters Monitored or Inspected	Additional guidance will be added to the inspection procedure to identify specific parameters to inspect.
	5. Monitoring and Trending	Additional guidance will be added to review maintenance activities since last inspection.
	6. Acceptance Criteria	Specific acceptance criteria will be added to the inspection procedures to be commensurate with industry codes, standards, and guidelines.

In addition the following FCS specific tasks will be added to the Structures Monitoring Program prior to the period of extended operation.

- Performance of periodic sampling and evaluation of ground water.
- Guidance to inspect structural components when exposed by excavation.

Operating Experience:

Inspections have been performed in the Auxiliary Building, Containment, Intake Structure, and Turbine Building in 1996/1997 and 1999/2000. No significant deterioration was identified. Some examples of corrosion of support anchors have been observed and documented under the FCS corrective action program.

Conclusion:

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

B.3 NEW AGING MANAGEMENT ACTIVITIES

B.3.1 ALLOY 600 PROGRAM

The FCS Alloy 600 Program will be consistent with the requirements of XI.M11, "*Nickel-Alloy Nozzles and Penetrations*," as identified in NUREG-1801 prior to the period of extended operation with the following exceptions:

- XI.M11-4. Detection of Aging Effects

  The FCS Alloy 600 Program will not rely on an enhanced leakage detection system for detection of leaks caused by primary water stress corrosion cracking (PWSCC) as suggested by XI.M11 in NUREG-1801. Bounding evaluations exist that demonstrate that PWSCC cracks can be detected via boric acid leakage prior to the structural integrity of the pressure boundary being compromised and prior to unacceptable material loss of carbon steel vessels due to boric acid corrosion.

- XI.M11-Program Description, 1. Scope of Program, and 2. Preventative Action.

  The Chemistry-related portions of the program are addressed in the FCS Chemistry Program.

The program includes participation in industry programs to determine an appropriate aging management program for SCC of Alloy 600 and PWSCC of Inconel 182 welds.

The scope of the FCS Alloy 600 program includes those plant specific components identified in Table 3.1.2 of this application for which the Alloy 600 Program is identified as an aging management program.

Operating Experience:

OPPD has proactively responded to industry experience with PWSCC of Alloy 600. In response to NRC Information Notice 90-10, "*Primary Water Stress Corrosion Cracking (PWSCC) of Inconel 600,"* OPPD initiated an investigation of the applications of Alloy 600, Alloy 82 and Alloy 182 in the FCS reactor coolant system. OPPD participated in the industry integrated inspection program used to respond to Generic Letter 97-01, *"Degradation of Control Rod Drive Mechanism Nozzle and Other Vessel Closure Head Penetrations,"* and is currently following industry developments related to circumferential cracking in control rod drive mechanisms (CRDMS) as described in NRC Bulletin 2001-01. Experience with weld PWSCC at V.C. Summer and a pressurizer instrument nozzle leak at FCS (both in October, 2000) prompted OPPD to review fabrication records of Alloy 82 and Alloy 182 welds and Alloy 600 components for evidence of fabrication rework, since this was identified as a causal factor in both incidents. In response to the V.C. Summer incident, FCS engineering staff briefed plant operators and inspection personnel to sensitize them to the potential for Alloy 82/182 butt weld cracks.

Conclusion:

The Alloy 600 Program provides reasonable assurance that the aging effects will be managed such that the components subject to aging management review will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.3.2 BURIED SURFACES EXTERNAL CORROSION PROGRAM

The Buried Surfaces External Corrosion Program will be consistent with XI.M34, "*Buried Piping and Tanks Inspection*," as identified in NUREG-1801 prior to the period of extended operation.

Operating Experience:

Tank wall thickness measurements, conducted as part of the Diesel Fuel Oil Monitoring and Storage Program for the emergency diesel generator and auxiliary boiler fuel oil storage tanks, have determined that there is no indication of external corrosion for either vessel.

As opportunities have arisen, visual inspections have been performed on excavated piping. A recent excavation for the repair of buried valves in the Fire Protection System also exposed sections of Raw Water System piping. The applied coatings and wrappings of the excavated Fire Protection and Raw Water System piping and components were found to be in good condition with no indication of loss of material from the metal beneath.

Conclusion:

The Buried Surfaces External Corrosion Program provides reasonable assurance that the identified aging effects will be managed such that the components subject to aging management review will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.3.3 GENERAL CORROSION OF EXTERNAL SURFACES PROGRAM

The General Corrosion of External Surfaces Program at FCS is credited for aging management of the effects of loss of material and cracking for applicable components, including piping, valves, supports, tanks, and bolting, which are made of cadmium plated steel, carbon steel, cast iron, copper alloy, galvanized steel, low alloy steel, and neoprene.

(1) Scope of Program

The General Corrosion of External Surfaces Program consists of several FCS activities that manage the aging effects of loss of material and cracking for components in the following systems:

- Auxiliary Boiler Fuel Oil
- Auxiliary Building HVAC
- Auxiliary Feedwater (AFW)
- Chemical and Volume Control
- Component Cooling Water (CCW)
- Containment HVAC
- Control Room HVAC
- Diesel Generator Lube Oil
- Diesel Jacket Water
- Starting Air
- Feedwater
- Fire Protection Fuel Oil
- Gaseous Waste Disposal
- Instrument Air
- Main Steam (MS) and Turbine Steam Extraction
- Containment Penetration, and System Interface Components for Non-CQE Systems
- Nitrogen Gas
- Primary Sampling
- Raw Water
- Ventilating Air

(2) Preventive Actions

This program does not prevent aging.

(3) Parameters Monitored or Inspected

Surface conditions of components are monitored through visual observation and inspection to detect signs of external corrosion and to detect conditions that can result in external corrosion, such as fluid leakage.

(4) Detection of Aging Effects

The aging effects of concern are loss of material and cracking. These effects can be detected by visual observation and inspection of external surfaces. Inspection for evidence of leaking fluids also provides indirect monitoring of certain components that are not routinely accessible.

(5) Monitoring and Trending

Various plant personnel including operators and system engineers perform periodic material condition inspections and observations outside containment. These inspections are performed in accordance with approved plant procedures. Evidence of fluid leaks, significant coating damage, or significant corrosion is documented.

Inspections and observations are performed at intervals based on previous inspections and industry experience. Operator rounds occur several times daily and system engineer walkdowns occur at least quarterly. Inspections inside containment are conducted each refueling outage by a team that includes knowledgeable subject matter experts from Engineering and Quality Control. The in-containment inspections for corrosion are part of the containment coatings inspections described in the OPPD response to NRC Generic Letter 98-04, "*Potential for Degradation of the Emergency Core Cooling System and the Containment Spray System after a Loss-of-Coolant Accident Because of Construction and Protective Coating Deficiencies and Foreign Material in Containment*."

(6) Acceptance Criteria

Plant procedures provide criteria for determining the acceptability of as-found conditions and for initiating the appropriate corrective action. The acceptance criteria and guidance are related to avoiding unacceptable degradation of the component intended functions, and include existence of leakage, presence of corrosion products, coating defects, and elastomer cracking. Appropriate provisions of NRC and industry guidance are incorporated.

(7) Corrective Action

The FCS corrective action process provides measures to verify completion and effectiveness of corrective action.

(8) Confirmation Process

The FCS corrective action process is in accordance with 10 CFR 50 Appendix B and includes:

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

(9) Administrative Controls

The procedures governing inspections and observations for external corrosion are subject to the site administrative controls process which implements the requirements of 10 CFR 50, Appendix B.

(10) Operating Experience

The activities relied on to detect loss of material, cracking, and fouling of accessible cadmium plated steel, carbon steel, cast iron, copper alloy, galvanized steel, low alloy steel, and neoprene component external surfaces and the precursors thereof are a subset of a larger number of inspection activities that result in redundant inspections. The activities credited for license renewal were selected based on their effectiveness as indicated by a review of site corrective action documents.

The activities are elements of established FCS programs that have been ongoing for years. They have been enhanced over the years based on site and industry experience. Review of plant records indicates they are effective in detecting loss of material due to corrosion and its precursors for accessible external surfaces. These findings are consistent with the findings of recent internal and external assessments of these activities, such as audits and NRC inspections.

Conclusion:

The General Corrosion of External Surfaces Program provides reasonable assurance that aging effects will be managed such that components subject to aging management review will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.3.4 NON-EQ CABLE AGING MANAGEMENT PROGRAM

The FCS Non-EQ Cable Aging Management Program establishes a service life value for the Non-EQ cable in a similar fashion as the FCS EQ Program establishes a Qualified Life for the safety related equipment, components, and cable. Non-EQ cable was purchased to the same requirements and specifications as that included in the EQ Program for the cable installed and qualified under the FCS 10 CFR 50.49 Environmental Qualification Program. Additional temperature and environmental data utilized to extend the qualified life of the EQ Program equipment and cables will be utilized to analyze and establish a service life for the Non-EQ cables. These analyses are relied upon to predict the life expectancy of the Non-EQ cable under the normal and abnormal plant operating conditions. Cables not capable of having a 60-year service life will be further analyzed using state of the art analytical techniques to determine if the service life can be further extended. Industry accepted and regulatory approved cable inspection techniques that provide aging related data, as well as state of the art in-situ, non-destructive testing of cable performance, and/or laboratory testing of cable to extend life, may also be considered should the aforementioned methodologies not succeed in extending the required service life.

EVALUATION AND TECHNICAL BASIS

(1) Scope of Program

The FCS Non-EQ Cable Aging Management Program is credited for managing the aging of all Non-EQ cables and connectors in the FCS plant electrical system subject to aging management review.

(2) Preventive Actions

The program does not prevent aging from occurring.

(3) Parameters Monitored or Inspected

The FCS Non-EQ Cable Program does not credit the inspections delineated within NUREG-1801 Section XI.E1, since specific analyses are provided for the Non-EQ cable which demonstrate that the cable will perform as intended. Additionally, this analysis takes credit for the manner in which the cable was procured, i. e., same as that in the EQ Program, and the methodology used to establish the 60 year service life.

(4) Detection of Aging Effects

The EQ program, as well as the program established for the Non-EQ cable, does not detect aging effects, but rather establishes a rate of aging based on analysis of materials (i.e., the insulation system). The material analysis includes consideration of material mechanical and electrical properties and their performance in ambient environments under operational conditions as well as self-heating effects. Additional environmental conditions such as humidity and radiation are also considered in the establishment of the service life. These analyses are relied upon to predict the life expectancy of the Non-EQ cable under the normal and abnormal plant operating conditions.

(5) Monitoring and Trending

The FCS Non-EQ Cable Aging Management Program establishes a service life value for the Non-EQ cable in a similar fashion as the FCS EQ Program establishes a Qualified Life for the safety related equipment, components, and cable. Non-EQ cable was purchased to the same requirements and specifications as that included in the EQ Program for the cable installed and qualified under the FCS 10 CFR 50.49 Environmental Qualification Program. Additional temperature and environmental data utilized to extend the qualified life of the EQ Program equipment and cables will be utilized to analyze and establish a service life for the Non-EQ cables.

(6) Acceptance Criteria

Acceptance criteria are based on the cable insulation service life (i.e., the predicted life expectancy). The service life evaluation of the cable insulation material includes consideration of material mechanical and electrical properties and their performance in ambient environments under operational conditions as well as self-heating effects. Additional environmental conditions such as humidity and radiation are also considered in the establishment of the service life. These analyses are relied upon to predict the life expectancy of the Non-EQ cable under the normal and abnormal plant operating conditions.

(7) Corrective Actions:

Cables for which a 60-year service life has not been or can not be demonstrated by state of the art analysis, inspection, or test, will be replaced prior to expiration of the established service life. This action is in accordance with the FCS 10 CFR 50 Appendix B corrective action process.

(8) Confirmation Process:

N/A. Cable replacement in accordance with the current licensing basis negates the need to confirm that the corrective action was effective in assuring the cable intended function(s). As noted above, the FCS corrective action process is in accordance with 10 CFR 50 Appendix B.

(9) Administrative Controls:

Non-EQ Cable Aging Management Program activities will be subject to the FCS administrative controls process, which is in accordance with 10 CFR 50 Appendix B and requires formal reviews and approvals.

(10) Operating Experience

This program is based on the EQ program, which has been shown through operating experience to be effective in managing cable aging. There is extensive industry and FCS experience in establishing and monitoring the service life of cables and other EQ equipment. The program will be improved, as appropriate, as additional industry experience becomes available.

Conclusion:

The FCS Non-EQ Cable Aging Management Program provides reasonable assurance that aging effects will be managed such that non-EQ cables subject to aging management review will continue to perform their intended functions consistent with the current licensing basis through the period on extended operation.

B.3.5 ONE-TIME INSPECTION PROGRAM

The FCS One-Time Inspection Program will be consistent with XI.M.32, "*One-Time Inspections*," as identified in NUREG-1801 prior to the period of extended operation. The scope of the FCS One-Time Inspection Program includes those plant specific components identified in Tables 3.3.2 and 3.4.2 of this application for which the One-Time Inspection Program is identified as an aging management program.

Operating Experience:

This is a new FCS program implemented to meet license renewal requirements specified in NUREG-1801. Results obtained from the required program inspections will be reviewed and documented in accordance with plant procedures. Corrective actions will be taken if necessary in accordance with the plant corrective action program.

Conclusion:

The One-Time Inspection Program will provide reasonable assurance that applicable aging effects will be managed such that the components subject to aging management review will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation

B.3.6 SELECTIVE LEACHING PROGRAM

The FCS Selective Leaching Program will be consistent with XI.M.33, "*Selective Leaching of Materials*," as identified in NUREG-1801 prior to the period of extended operation, with the following clarification:

- XI.M33-Program Description, 3. Parameters Monitored/Inspected, and 4. Detection of Aging Effects

  OPPD does not perform hardness measurement, because brasses, bronzes, and other copper-alloys do not have hardness acceptance criteria. For cast irons, graphitization is easily visually identified and the ASTM and ASME standards do not prescribe hardness acceptance criteria.

The scope of the FCS Selective Leaching Program includes those plant specific components identified in Tables 3.2.2, 3.3.2, 3.3.3, 3.4.2, 3.5.2, and 3.5.3 of this application for which the Selective Leaching Program is identified as an aging management program.

Operating Experience:

FCS operating experience has revealed no problems related to selective leaching.

Conclusion:

The Selective Leaching Program provides reasonable assurance that the aging effects will be managed such that the components subject to aging management review will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.3.7 THERMAL AGING EMBRITTLEMENT OF CAST AUSTENITIC STAINLESS STEEL

The FCS Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) Program will be consistent with XI.M12, "*Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)*," as identified in NUREG-1801 prior to the period of extended operation.

Operating Experience:

No age related degradiation associated with thermal embrittlement of CASS was identified in the FCS operating experience.

Conclusion:

The FCS Thermal Aging Embrittlement of Cast Austenitic Stainless Steel Program provides reasonable assurance that the aging effects will be managed such that components subject to aging management review will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.