TABLE 3.1-1
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM EVALUATED IN NUREG-1801 THAT ARE RELIED ON FOR FCS LICENSE RENEWAL

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1.01	Reactor coolant pressure boundary components	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801 except as noted in item 4 below. 2. The metal fatigue time limited aging analyses are discussed in Section 4.3. 3. Consistent with NUREG-1801, this group includes the low alloy steel and carbon steel with stainless steel cladding, stainless steel, CASS, and nickel alloy in borated treated water; and low alloy steel in deoxygenated water and steam at FCS. 4. Cumulative fatigue damage is not an aging effect requiring management for control element assembly shroud bolts and core support barrel snubber assembly socket head cap screws. These components are preloaded to prevent fatigue cycles.

TABLE 3.1-1
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM EVALUATED IN NUREG-1801 THAT ARE RELIED ON FOR FCS LICENSE RENEWAL

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1.02	Steam generator shell assembly	Loss of material due to pitting and crevice corrosion	Inservice inspection; water chemistry	Yes, detection of aging effects is to be further evaluated	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801. 2. This aging effect is managed by the Inservice Inspection Program (B.1.6), the Chemistry Program (B.1.2) and the Steam Generator Program (B.2.9). The Steam Generator Program includes methods to detect general, crevice and pitting corrosion discussed in NUREG-1801, Volume 2, IV.D1.1-c. These programs are described in Appendix B of this application. 3. Consistent with NUREG-1801, this group includes carbon steel in deoxygenated treated water at FCS.
3.1.1.03	Pressure vessel ferritic materials that have a neutron fluence greater than 10^{17} n/cm^2 (E>1 MeV)	Loss of fracture toughness due to neutron irradiation embrittlement	TLAA, evaluated in accordance with Appendix G of 10 CFR 50 and RG 1.99	Yes, TLAA	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801. 2. The reactor vessel neutron embrittlement time limited aging analyses are discussed in Section 4.2. 3. Consistent with NUREG-1801, this group includes low alloy steel with stainless steel cladding in borated treated water.

TABLE 3.1-1
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM EVALUATED IN NUREG-1801 THAT ARE RELIED ON FOR FCS LICENSE RENEWAL

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1.04	Reactor vessel beltline shell and welds	Loss of fracture toughness due to neutron irradiation embrittlement	Reactor vessel surveillance	Yes, plant specific	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801. 2. The Reactor Vessel Integrity Program (B.1.7) manages this aging effect. This program is described in Appendix B of this application. 3. Consistent with NUREG-1801, this group includes low alloy steel with stainless steel cladding in borated treated water.
3.1.1.05	Westinghouse and B&W baffle/former bolts	Loss of fracture toughness due to neutron irradiation embrittlement and void swelling	Plant specific	Yes, plant specific	This item is not applicable since FCS is Combustion Engineering designed and manufactured reactor.

TABLE 3.1-1
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM EVALUATED IN NUREG-1801 THAT ARE RELIED ON FOR FCS LICENSE RENEWAL

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1.06	Small-bore reactor coolant system and connected systems piping	Crack initiation and growth due to SCC, intergranular SCC, and thermal and mechanical loading	Inservice inspection; water chemistry; one-time inspection	Yes, parameters monitored/inspected and detection of aging effects are to be further evaluated	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801. 2. This aging effect is managed by the Inservice Inspection Program (B1.6), the Chemistry Program (B1.2) and the One-Time Inspection Program (B3.5) These programs are described in Appendix B of this application. The One-Time Inspection Program verifies that service-induced weld cracking is not occurring in the small-bore piping less than NPS 4, including pipe, fittings, and branch connections. 3. Consistent with NUREG-1801, this group includes stainless steel in borated treated water at FCS.
3.1.1.07	Vessel shell	Crack growth due to cyclic loading	TLAA	Yes, TLAA	Underclad crack growth due to cyclic loading was not identified as a TLAA for FCS.
3.1.1.08	Reactor internals	Changes in dimension due to void swelling	Plant specific	Yes, plant specific	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801 with the exception noted in item 4 below. 2. This aging effect is managed by the Reactor Vessel Internals Inspection Program (B2.8). FCS will continue to

TABLE 3.1-1
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM EVALUATED IN NUREG-1801 THAT ARE RELIED ON FOR FCS LICENSE RENEWAL

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
					participate in industry programs to investigate aging effects and determine appropriate aging management programs. This program is described in Appendix B of this application. 3. Consistent with NUREG-1801, this group includes the stainless steel in borated treated water at FCS. 4. Changes in dimension due to void swelling are not an aging effect requiring management for some reactor internals components because the intended function of the component is not affected. As noted in the Safety Evaluation Report Related to the License Renewal of Arkansas Nuclear One, Unit 1, the specific impacts of concern for void swelling are constriction of flow paths, interference with control rod insertion and excessive baffle bolt loading. This is consistent with NUREG-1705, *Safety Evaluation Report Related to the License Renewal of Calvert Cliffs Nuclear Power Plant, Units 1 and 2 (Final Report)*, and NUREG-1723*Safety Evaluation Report Related to the License Renewal of Oconee Nuclear Station, Units 1, 2 and 3.* Swelling of certain components does not impact the noted concerns. These

TABLE 3.1-1
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM EVALUATED IN NUREG-1801 THAT ARE RELIED ON FOR FCS LICENSE RENEWAL

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
					components are the core support barrel alignment key, core support barrel fasteners, core support barrel locking collar, core support barrel spacer, core support barrel upper flange, upper guide structure alignment lug (NUREG-1801 FAP guide lug), upper guide structure fasteners, upper guide structure guide pins, hold down ring, upper guide structure locking strip, upper guide structure plate (a support for an instrument tube), upper guide structure shim ring, upper guide structure tab, thermal shield positioning pins and screws, thermal shield pins, thermal shield shim, lower internals anchor block, lower internals fasteners, lower vessel internals dowel pins, core shroud fasteners, control element assembly shroud nuts and bolts, in-core instrumentation guide tubes (above instrumentation support plate), in-core instrumentation guide tube fasteners, in-core instrumentation support plate and gussets.

TABLE 3.1-1
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM EVALUATED IN NUREG-1801 THAT ARE RELIED ON FOR FCS LICENSE RENEWAL

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1.09	PWR core support pads, instrument tubes (bottom head penetrations), pressurizer spray heads, and nozzles for the steam generator instruments and drains	Crack initiation and growth due to SCC and/or primary water stress corrosion cracking (PWSCC)	Plant specific	Yes, plant specific	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801. 2. This aging effect is managed by the Alloy 600 Program (B3.1). This program is described in Appendix B of this application. 3. Consistent with NUREG-1801, this group includes Alloy 600 in borated treated water at FCS. The vessel flange leak detection line at FCS is made of Alloy 600.
3.1.1.10	Cast austenitic stainless steel (CASS) reactor coolant system piping	Crack initiation and growth due to SCC	Plant specific	Yes, plant specific	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801. 2. This aging effect is managed by the Chemistry Program (B.1.2), the Inservice Inspection Program (B.1.6) and the Thermal Embrittlement of Cast Austenitic Stainless Steel Program (B.3.7). These programs are described in Appendix B of this application. 3. Consistent with NUREG-1801, this group includes cast austenitic stainless steel (CASS) reactor coolant system piping.

TABLE 3.1-1
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM EVALUATED IN NUREG-1801 THAT ARE RELIED ON FOR FCS LICENSE RENEWAL

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1.11	Pressurizer instrumentation penetrations and heater sheaths and sleeves made of Ni-alloys	Crack initiation and growth due to PWSCC	Inservice inspection; water chemistry	Yes, AMP for PWSCC of Inconel 182 weld is to be evaluated	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801. 2. This aging effect is managed by the Alloy 600 Program (B.3.1), Chemistry Program (B.1.2) and Inservice Inspection Program (B.1.6) These programs are described in Appendix B of this application. The Alloy 600 Program manages the AERM of PWSCC in Inconel 182 welds. 3. Consistent with NUREG-1801, this group includes Alloy 600 and nickel alloys in borated treated water at FCS.
3.1.1.12	Westinghouse and B&W baffle former bolts	Crack initiation and growth due to SCC and IASCC	Plant specific	Yes, plant specific	This item is not applicable since FCS is a Combustion Engineering designed and manufactured reactor.
3.1.1.13	Westinghouse and B&W baffle former bolts	Loss of preload due to stress relaxation	Plant specific	Yes, plant specific	This item is not applicable since FCS is a Combustion Engineering designed and manufactured reactor.

TABLE 3.1-1 SUMMARY OF AGING MANAGEMENT PROGRAMS FOR REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM EVALUATED IN NUREG-1801 THAT ARE RELIED ON FOR FCS LICENSE RENEWAL					
Row Number	**Component**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.1.1.14	Steam generator feedwater impingement plate and support	Loss of section thickness due to erosion	Plant specific	Yes, plant specific	The components identified in NUREG-1801 Volume 2 IV.D1.1-e are not applicable to FCS.

TABLE 3.1-1
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM EVALUATED IN NUREG-1801 THAT ARE RELIED ON FOR FCS LICENSE RENEWAL

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1.15	(Alloy 600) Steam generator tubes, repair sleeves, and plugs	Crack initiation and growth due to PWSCC, outside diameter stress corrosion cracking (ODSCC), and/or intergranular attack (IGA) or loss of material due to wastage and pitting corrosion, and fretting and wear; or deformation due to corrosion at tube support plate intersections	Steam generator tubing integrity; water chemistry	Yes, effectiveness of a proposed AMP is to be evaluated	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801. 2. This aging effect is managed by the Steam Generator Program (~~B1.7~~B.2.9[27]) and Chemistry Program (B.1.2). These programs are described in Appendix B of this application. The FCS Technical Specifications have already incorporated the NRC-approved basis for steam generator degradation management. 3. Consistent with NUREG-1801, this group includes Alloy 600 in borated treated and deoxygenated treated water. 4. Combustion Engineering (Westinghouse) mechanical and welded steam generator tube plugs are installed at FCS. 5. NUREG-1801 IV.D 1.2-f is not pertinent to FCS, as phosphate chemistry has never been used. Regarding NUREG-1801 IV.D 1.2-g, FCS did not require analysis in accordance with NRC Bulletin 88-02.

[27] RAI # 3.1.1-1

TABLE 3.1-1
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM EVALUATED IN NUREG-1801 THAT ARE RELIED ON FOR FCS LICENSE RENEWAL

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1.16	Tube support lattice bars made of carbon steel	Loss of section thickness due to FAC	Plant specific	Yes, plant specific	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801. 2. The inspection of the tube support lattice bars for loss of thickness is included in the Steam Generator Program (B.2.9) described in Appendix B of this application. 3. Consistent with NUREG-1801, this group includes carbon steel in deoxygenated water.
3.1.1.17	Carbon steel tube support plate	Ligament cracking due to corrosion	Plant specific	Yes, effectiveness of a proposed AMP is to be evaluated	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801. 2. This aging effect is managed by the Steam Generator Program (B.2.9) and Chemistry Program (B.1.2). These programs are described in Appendix B of this application. The FCS Technical Specifications have already incorporated the NRC-approved guidance for steam generator degradation management. 3. Consistent with NUREG-1801, this group includes carbon steel in deoxygenated water.

TABLE 3.1-1
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM EVALUATED IN NUREG-1801 THAT ARE RELIED ON FOR FCS LICENSE RENEWAL

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1.18	Steam generator feedwater inlet ring and supports	Loss of material due to flow-corrosion	Combustion engineering (CE) steam generator feedwater ring inspection	Yes, plant specific	As stated in NUREG-1801 Volume 2 VI.D1.3-a, this effect is only applicable to certain CE System 80 steam generators. Because of difference in design between the FCS steam generators and the System 80 steam generators, this effect is not applicable to FCS.
3.1.1.19	Reactor vessel closure studs and stud assembly	Crack initiation and growth due to SCC and/or IGSCC	Reactor head closure studs	No	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801. 2. Consistent with NUREG-1801, this group includes low alloy steel in air possibly exposed to borated treated water. 3. The Reactor Head Closure Studs Program is incorporated into the Bolting Integrity Program at FCS.
3.1.1.20	CASS pump casing and valve body	Loss of fracture toughness due to thermal aging embrittlement	Inservice inspection	No	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801. 2. Consistent with NUREG-1801, this group includes CASS in borated treated water.

TABLE 3.1-1
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM EVALUATED IN NUREG-1801 THAT ARE RELIED ON FOR FCS LICENSE RENEWAL

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1.21	CASS piping	Loss of fracture toughness due to thermal aging embrittlement	Thermal aging embrittlement of CASS	No	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801. 2. Consistent with NUREG-1801, this group includes CASS in borated treated water.
3.1.1.22	BWR piping and fittings; steam generator components	Wall thinning due to flow-accelerated corrosion	Flow-accelerated corrosion	No	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801. 2. Consistent with NUREG-1801, this group includes carbon steel in deoxygenated treated water.
3.1.1.23	Reactor coolant pressure boundary (RCPB) valve closure bolting, manway and holding bolting, and closure bolting in high pressure and high temperature systems	Loss of material due to wear; loss of preload due to stress relaxation; crack initiation and growth due to cyclic loading and/or SCC	Bolting integrity	No	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801. 2. Consistent with NUREG-1801, this group includes stainless steel, low alloy steel and carbon steel in air possibly exposed to borated treated water.

TABLE 3.1-1
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM EVALUATED IN NUREG-1801 THAT ARE RELIED ON FOR FCS LICENSE RENEWAL

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1.24	CRD nozzle	Crack initiation and growth due to PWSCC	Ni-alloy nozzles and penetrations; water chemistry	No	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801. 2. Consistent with NUREG-1801, this group includes Alloy 600 in borated treated water.
3.1.1.25	Reactor vessel nozzles safe ends and CRD housing; reactor coolant system components (except CASS and bolting) Note that NUREG-1801 Volume 2 items IV.C2.3-b and IV.C2.4-b, that include CASS, are included in this group.	Crack initiation and growth due to cyclic loading, and/or SCC, and PWSCC	Inservice inspection; water chemistry	No	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801. 2. Consistent with NUREG-1801, this group includes stainless steel, austenitic stainless steel, Alloy 600 and carbon or low alloy steel clad with stainless steel in borated treated water.

TABLE 3.1-1
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM EVALUATED IN NUREG-1801 THAT ARE RELIED ON FOR FCS LICENSE RENEWAL

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1.26	Reactor vessel internals CASS components	Loss of fracture toughness due to thermal aging, neutron irradiation embrittlement, and void swelling	Thermal aging and neutron irradiation embrittlement	No	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801. 2. Consistent with NUREG-1801, this group includes CASS in borated treated water.
3.1.1.27	External surfaces of carbon steel components in reactor coolant system pressure boundary	Loss of material due to boric acid corrosion	Boric acid corrosion	No	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801. 2. Consistent with NUREG-1801, this group includes carbon steel and low alloy steel in air possibly exposed to borated treated water.
3.1.1.28	Steam generator secondary manways and handholds (CS)	Loss of material due to erosion	Inservice inspection	No	These items are not applicable since FCS is a Combustion Engineering designed and manufactured reactor.
3.1.1.29	Reactor internals, reactor vessel closure studs, and core support pads	Loss of material due to wear	Inservice inspection	No	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801. Consistent with NUREG-1801, this group includes low alloy steel and stainless steel in borated treated water.
3.1.1.30	Pressurizer integral support	Crack initiation and growth due to cyclic loading	Inservice inspection	No	The component identified in NUREG-1801 is not applicable to FCS.

TABLE 3.1-1
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM EVALUATED IN NUREG-1801 THAT ARE RELIED ON FOR FCS LICENSE RENEWAL

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1.31	Upper and lower internals assembly (Westinghouse)	Loss of preload due to stress relaxation	Inservice inspection; loose part and/or neutron noise monitoring	No	These items are not applicable since FCS is a Combustion Engineering designed and manufactured reactor.
3.1.1.32	Reactor vessel internals in fuel zone region (except Westinghouse and Babcock & Wilcox [B&W] baffle bolts)	Loss of fracture toughness due to neutron irradiation embrittlement, and void swelling	PWR vessel internals~~; water chemistry~~	No	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801. 2. Consistent with NUREG-1801, this group includes stainless steel and nickel alloys in borated treated water. *3. Water Chemistry is not cited in any of the "Item Numbers in GALL" in Table 1, Vol. 1 of NUREG-1801.*
3.1.1.33	Steam generator upper and lower heads Primary manway cladding; tubesheets; primary nozzles and safe ends	Crack initiation and growth due to SCC, PWSCC. IASCC	Inservice inspection; water chemistry	No	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801. 2. Consistent with NUREG-1801, this group includes stainless steel in borated treated water.
3.1.1.34	Vessel internals (except Westinghouse and B&W baffle former bolts)	Crack initiation and growth due to SCC and IASCC	PWR vessel internals; water chemistry	No	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801. 2. Consistent with NUREG-1801, this group includes stainless steel, nickel alloys and CASS in borated treated water.

TABLE 3.1-1
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM EVALUATED IN NUREG-1801 THAT ARE RELIED ON FOR FCS LICENSE RENEWAL

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1.35	Reactor internals (B&W screws and bolts)	Loss of preload due to stress relaxation	Inservice inspection; loose part monitoring	No	These items are not applicable since FCS is a Combustion Engineering designed and manufactured reactor.
3.1.1.36	Reactor vessel closure studs and stud assembly	Loss of material due to wear	Reactor head closure studs	No	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801. 2. Consistent with NUREG-1801, this group includes high strength steel in air possibly exposed to borated treated water. 3. The Reactor Head Closure Studs Program is incorporated into the Bolting Integrity Program at FCS.
3.1.1.37	Reactor internals (Westinghouse upper and lower internal assemblies; CE bolts and tie rods)	Loss of preload due to stress relaxation	Inservice inspection; loose part monitoring	No	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801 with the deviation that FCS does not credit the Loose Parts Monitoring Program as discussed in NUREG-1801 Volume 2 IV.B3.2-g and IV.B3.4-h. 2. The Reactor Vessel Internals Inspection Program as described in Appendix B.2.8 of this application manages this aging effect. 3. Consistent with NUREG-1801, this group includes nickel alloy and stainless steel in borated treated water.

Red & Italics – Review based changes
Blue & Bold – RAI based changes

TABLE 3.1-2 FCS REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM COMPONENT TYPES SUBJECT TO AGING MANAGEMENT NOT EVALUATED IN NUREG-1801					
Row Number	**Component Types**	**Material**	**Environment**	**AERMs**	**Program/Activity**
3.1.2.01	External surfaces of stainless steel components in reactor coolant system pressure boundary	Stainless Steel	Ambient Air	None	Not Applicable
3.1.2.02	Pressurizer heater sleeves, steam generator - tubes, ICI nozzles, nozzle safe ends, CEDM and incore instrument housings, reactor head vent pipe, pressurizer bottom head plate cladding, steam generator primary head cladding and shock suppressors & supports, nozzle welds, thermal sleeves	Nickel Based Alloy including Alloy 600	Borated Treated Water	Loss of Material Crevice corrosion in the presence of sufficient levels of oxygen, halogens, sulfates, or copper.	Chemistry Program (B.1.2) **and One Time Inspection Program (B.3.5)**[28]

[28] **RAI # 3.1.2-5**

TABLE 3.1-2
FCS REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM COMPONENT TYPES SUBJECT TO AGING MANAGEMENT NOT EVALUATED IN NUREG-1801

Row Number	Component Types	Material	Environment	AERMs	Program/Activity
3.1.2.03	External surfaces of nickel based alloy components in reactor coolant system pressure boundary	Nickel Based Alloy including Alloy 600	Ambient Air	None	Not Applicable
3.1.2.04	Steam generator lower head and manway cladding and primary side tube sheet	Nickel Based Alloy	Borated Treated Water	Cracking	Chemistry Program (B.1.2) **and Steam Generator Program (B.2.9)**[29]
3.1.2.05	Reactor coolant pump thermal barrier	Cast Austenitic Stainless Steel (CASS)	Corrosion-Inhibited Treated Water	Cracking	Chemistry Program (B.1.2) **and One-Time Inspection Program (B.3.5)**[24]
3.1.2.06	Secondary side of the tubesheet, steam generator feedwater, steam and instrument nozzles, and feedwater nozzle safe ends, *blowdown nozzles*	Low-Alloy Steel	Deoxygenated Treated Water	Loss of Material • General and crevice due to the exposure of low-alloy steel to dissolved oxygen • Pitting corrosion due to the exposure of low-alloy steel to halogens and sulfates	Chemistry Program (B.1.2), Steam Generator Program (B.2.9) ~~*and Inservice Inspection Program (B.1.6))*~~
3.1.2.07	**Not Used**[30]				

[29] **RAI # 3.1.2-1**
[30] **RAI # B.2.9-2**

TABLE 3.1-2
FCS REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM COMPONENT TYPES SUBJECT TO AGING MANAGEMENT NOT EVALUATED IN NUREG-1801

Row Number	Component Types	Material	Environment	AERMs	Program/Activity
3.1.2.08	Reactor vessel internals – flow skirt	Alloy 600	Borated Treated Water	Changes in Dimensions Void swelling as a result of helium bubble nucleation and growth from nuclear transmutation reactions of nickel or boron in the austenitic stainless steel or nickel-based alloy material.	Reactor Vessel Internals Inspection Program
3.1.2.09	Reactor vessel internals – flow skirt	Alloy 600	Borated Treated Water	Cracking • Primary Water Stress Corrosion Cracking • irradiation-assisted stress corrosion cracking in the presence of oxygen concentrations > 5 ppb, halogen concentrations > 150 ppb, and fluence levels > 5 E20 n/cm2	Alloy 600 Program
3.1.2.10	Reactor vessel internals – flow skirt	Alloy 600	Borated Treated Water	Fatigue Due to repeated stress/strain cycles caused by fluctuating loads and temperatures	Fatigue Monitoring Program
3.1.2.11	Reactor vessel internals – flow skirt	Alloy 600	Borated Treated Water	Reduction of Fracture Toughness Due to changes in the properties of the stainless steel and nickel-base alloys used in reactor internals	Reactor Vessel Internals Inspection Program

TABLE 3.1-2
FCS REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM COMPONENT TYPES SUBJECT TO AGING MANAGEMENT NOT EVALUATED IN NUREG-1801

Row Number	Component Types	Material	Environment	AERMs	Program/Activity
3.1.2.12	Steam generator secondary manway steel bolts.	Carbon Steel	Ambient Air	Loss of preload Due to stress relaxation in high temperature environments.	Bolting Integrity Program
3.1.2.13	Pressurizer manway cover plate, SG feedwater and steam nozzle safe ends	Carbon Steel	Ambient Air	Loss of Material Due to the exposure to leaking boric acid	Boric Acid Corrosion Prevention Program
3.1.2.14	Steam generator steam nozzle safe end, steam generator feed ring, *steam generator shell*	Carbon Steel	Deoxygenated Treated Water	Loss of Material • General and ~~*pitting*~~ *crevice* corrosion due to the exposure to dissolved oxygen • pitting corrosion due to the exposure to halogens and sulfates	Chemistry Program (B.1.2), Steam Generator Program (B.2.9) ~~*and Inservice Inspection Program (B.1.6)*~~
3.1.2.15	Pressurizer base	Low-Alloy Steel	Ambient Air	Loss of Material Due to the exposure to leaking boric acid	Boric Acid Corrosion Prevention Program
3.1.2.16	Pressurizer relief valve and Instrument nozzle, nozzle inserts	Nickel Based Alloy	Borated Treated Water	Cracking Stress corrosion cracking due to potential exposure to halogens or sulfates.	Chemistry Program (B.1.2) and Inservice Inspection Program (B.1.6)

Red & Italics – Review based changes
Blue & Bold – RAI based changes

TABLE 3.1-3
Components in Reactor Vessel, Internals, and Reactor Coolant System not Evaluated in NUREG-1801 that Rely on Aging Management Programs in NUREG-1801 for FCS License Renewal

Row Number	FCS Components	FCS Material	FCS Environment	FCS AERMs	FCS Program Activity	Applicable NUREG-1801 AMR Results Row Number	Justification for applying NUREG-1801 Aging Management Review Results
3.1.3.01	Thermal Shield and Thermal Shield Positioning Pin & Bolt	Stainless Steel	High Temp/Neutron Fluence/ Borated Treated Water	Cracking	Chemistry Program (B.1.2)	3.1.1.34	The FCS components are made of the same material, exposed to the same environment, subject to the same aging effects and managed by the same aging management program as the components evaluated in NUREG-1801 Volume 2 IV.B3.4-a and IV.B3.4-e
3.1.3.02	Thermal Shield and Thermal Shield Positioning Pin & Bolt	Stainless Steel	High Temp/Neutron Fluence/ Borated Treated Water	Cracking	Reactor Vessel Internals Inspection Program (B.2.8)	3.1.1.34	The FCS components are made of the same material, exposed to the same environment, subject to the same aging effects and managed by the same aging management program as the components evaluated in NUREG-1801 Volume 2 IV.B3.4-a and IV.B3 4-e

TABLE 3.1-3
Components in Reactor Vessel, Internals, and Reactor Coolant System not Evaluated in NUREG-1801 that Rely on Aging Management Programs in NUREG-1801 for FCS License Renewal

Row Number	FCS Components	FCS Material	FCS Environment	FCS AERMs	FCS Program Activity	Applicable NUREG-1801 AMR Results Row Number	Justification for applying NUREG-1801 Aging Management Review Results
3.1.3.03	Bolt - Thermal Shield	Stainless Steel	High Temp/Neutron Fluence/ Borated Treated Water	Loss of preload	Inservice Inspection Program (B1.6)	3.1-1.37	The FCS components are made of the same material, exposed to the same environment, subject to the same aging effects and managed by the same aging management program as the components evaluated in NUREG-1801 Volume 2 IV.B3.4-h
3.1.3.04	Thermal Shield and Thermal Shield Positioning Pin & Bolt	Stainless Steel	High Temp/Neutron Fluence/ Borated Treated Water	Reduction of Fracture Toughness	Reactor Vessel Integrity Program (B.1.7)	3.1-1.32	The FCS components are made of the same material, exposed to the same environment, subject to the same aging effects and managed by the same aging management program as the components evaluated in NUREG-1801 Volume 2 IV.B3.4-c and IV.B3.4-g

TABLE 3.1-3
Components in Reactor Vessel, Internals, and Reactor Coolant System not Evaluated in NUREG-1801 that Rely on Aging Management Programs in NUREG-1801 for FCS License Renewal

Row Number	FCS Components	FCS Material	FCS Environment	FCS AERMs	FCS Program Activity	Applicable NUREG-1801 AMR Results Row Number	Justification for applying NUREG-1801 Aging Management Review Results
3.1.3.05	Thermal Shield ~~and Thermal Shield Positioning Pin & Bolt~~	Stainless Steel	High Temp/Neutron Fluence/ Borated Treated Water	Changes in Dimensions	Reactor Vessel Internals Inspection Program (B.2.8)	3.1.1.08	The FCS components are made of the same material, exposed to the same environment, subject to the same aging effects and managed by the same aging management program as the components evaluated in NUREG-1801 Volume 2 IV.B3.4-b
3.1.3.06	Reactor coolant valves including PORV, drain valves, head and pressurizer vent valves, instrument isolation valves etc.	Stainless Steel	Borated treated water	Cracking	Chemistry (B.1.2) and Inservice Inspection Programs (B.1.6)	3.1.1.25	The FCS components are made of the same material, exposed to the same environment, subject to the same aging effects and managed by the same aging management programs as the components evaluated in NUREG-1801 Volume 2 IV.C2.2-f
3.1.3.07	Not used in application						

TABLE 3.1-3
Components in Reactor Vessel, Internals, and Reactor Coolant System not Evaluated in NUREG-1801 that Rely on Aging Management Programs in NUREG-1801 for FCS License Renewal

Row Number	FCS Components	FCS Material	FCS Environment	FCS AERMs	FCS Program Activity	Applicable NUREG-1801 AMR Results Row Number	Justification for applying NUREG-1801 Aging Management Review Results
3.1.3.08	Feedwater nozzle safe end	Low-Alloy Steel	Containment Air	Loss of Material	Boric Acid Corrosion Prevention Program (B.2.1)	3.1.1.27	The FCS components are made of the same material, exposed to the same environment, subject to the same aging effects and managed by the same aging management programs as the components evaluated in NUREG-1801 Volume 2 IV.D1.1-g
3.1.3.09	Reactor coolant pump driver mounts	Carbon Steel	Containment Air	Loss of Material	Boric Acid Corrosion Prevention Program (B.2.1)	3.1.1.27	The FCS components are made of the same material, exposed to the same environment, subject to the same aging effects and managed by the same aging management programs as the components evaluated in NUREG-1801 Volume 2 IV.C2.3-f

TABLE 3.1-3
Components in Reactor Vessel, Internals, and Reactor Coolant System not Evaluated in NUREG-1801 that Rely on Aging Management Programs in NUREG-1801 for FCS License Renewal

Row Number	FCS Components	FCS Material	FCS Environment	FCS AERMs	FCS Program Activity	Applicable NUREG-1801 AMR Results Row Number	Justification for applying NUREG-1801 Aging Management Review Results
3.1.3.10	Pressurizer relief valve external portion of body	Carbon Steel	Containment Air	Loss of Material	Boric Acid Corrosion Prevention Program (B.2.1)	3.1.1.27	The FCS components are made of the same material, exposed to the same environment, subject to the same aging effects and managed by the same aging management programs as the components evaluated in NUREG-1801 Volume 2 IV.C2.4-f
3.1.3.11	Reactor vessel nozzles and safe ends~~, pressurizer shell~~	Low-Alloy Steel	Containment Air	Loss of Material	Boric Acid Corrosion Prevention Program (B.2.1)	3.1.1.27	The FCS components are made of the same material, exposed to the same environment, subject to the same aging effects and managed by the same aging management programs as the components evaluated in NUREG-1801 Volume 2 IV.A2.1-a
3.1.3.12	Steam generator feedwater and steam nozzles	Low-Alloy Steel	Deoxygenated Treated Water	Loss of Material	Flow-Accelerated Corrosion Program (B.1.5)	3.1.1.22	The material is subject to the same environment and aging effect, and managed by the same aging management program as evaluated in Table 3.1.1.22. The aging effect is independent of component type.

TABLE 3.1-3
Components in Reactor Vessel, Internals, and Reactor Coolant System not Evaluated in NUREG-1801 that Rely on Aging Management Programs in NUREG-1801 for FCS License Renewal

Row Number	FCS Components	FCS Material	FCS Environment	FCS AERMs	FCS Program Activity	Applicable NUREG-1801 AMR Results Row Number	Justification for applying NUREG-1801 Aging Management Review Results
3.1.3.13	ICI Nozzles, RV Vent Nozzle	Alloy 600	Borated Treated Water	Cracking	Chemistry Program (B.1.2) Alloy 600 Program (B 3.1)	3.1.1.24	The FCS components are made of the same material, exposed to the same environment, subject to the same aging effects and managed by the same aging management programs as the components evaluated in NUREG-1801 Volume 2 IV.A2.2-a and IV.A2.7-b
3.1.3.14	Thermal Shield	Stainless Steel	High Temp/Neutron Fluence/ Borated Treated Water	Fatigue	TLAA	3.1.1.01	The FCS components are made of the same material, exposed to the same environment, subject to the same aging effects and managed by the same aging management programs as the components evaluated in NUREG-1801 Volume 2 IV.B3.4-d

Red & Italics – Review based changes
Blue & Bold – RAI based changes

TABLE 3.2-1
Summary of Aging Management Programs for Engineered Safety Features Evaluated in NUREG-1801 that are Relied on for FCS License Renewal

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.2.1.01	Piping, fittings, and valves in emergency core cooling system	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801. 2. The metal fatigue time limited aging analyses are discussed in Section 4.3.
3.2.1.02	Components in containment spray (PWR only), standby gas treatment (BWR only), containment isolation, and emergency core cooling systems	Loss of material due to general corrosion	Plant specific	Yes, plant specific	The applicable FCS components, materials and environments identified in NUREG-1801 are discussed in row number 3.2.1.06 of this table.

TABLE 3.2-1
Summary of Aging Management Programs for Engineered Safety Features Evaluated in NUREG-1801 that are Relied on for FCS License Renewal

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.2.1.03	Components in containment spray (PWR only), standby gas treatment (BWR only), containment isolation, and emergency core cooling systems	Loss of material due to pitting and crevice corrosion	Plant specific	Yes, plant specific	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801. 2. The Chemistry Program (B.1.2) supplemented by the One Time Inspection Program (B.3.5) to verify the effectiveness of the chemistry program manage the aging effects of these components. These programs are described in Appendix B of this application. 3. Consistent with NUREG-1801, this group only includes stainless steel in oxygenated treated water for components in containment isolation at FCS
3.2.1.04	Containment isolation valves and associated piping	Loss of material due to microbiologically influenced corrosion	Plant specific	Yes, plant specific	No FCS containment isolation valves and associated piping in systems that are ~~not~~[31] addressed in this or other sections of this application were determined to be subject to the aging effect of loss of material due to microbiologically influenced corrosion
3.2.1.05	High pressure safety injection (charging) pump miniflow orifice	Loss of material due to erosion	Plant specific	Yes, plant specific	The component identified in NUREG-1801 is not applicable to FCS.

[31] RAI # 3.2.1-1

TABLE 3.2-1
Summary of Aging Management Programs for Engineered Safety Features Evaluated in NUREG-1801 that are Relied on for FCS License Renewal

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.2.1.06	External surface of carbon steel components *This row is only found in Table 2 Nureg-1801 Volume1. It is not found in Table 3.2-1 of NUREG-1800.*	Loss of material due to general corrosion	Plant specific	Yes, plant specific	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801. 2. The General Corrosion of External Surfaces Program (B.3.3) manages the aging effects of these components. This program is described in Appendix B of this application. 3. Consistent with NUREG-1801, this group includes carbon steel components in ambient air at FCS.
3.2.1.07	Piping and fittings of CASS in emergency core cooling system	Loss of fracture toughness due to thermal aging embrittlement	Thermal aging embrittlement of CASS	No	The material identified in NUREG-1801 is not applicable to FCS. CASS piping and fittings are not sued in the ESF systems at FCS.
3.2.1.08	Components serviced by open-cycle cooling system	Local loss of material due to corrosion and/or buildup of deposit due to biofouling	Open-cycle cooling water system	No	The FCS ESF components are not serviced by open-cycle cooling system.

TABLE 3.2-1
Summary of Aging Management Programs for Engineered Safety Features Evaluated in NUREG-1801 that are Relied on for FCS License Renewal

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.2.1.09	Components serviced by closed-cycle cooling system	Loss of material due to general, pitting, and crevice corrosion	Closed-cycle cooling water system	No	1. The aging management results are consistent with the results documented in NUREG-1801. 2. Consistent with NUREG-1801, this group includes stainless steel, carbon steel and cast iron in corrosion-inhibited treated water at FCS. *3. At FCS, the "Closed Cycle Cooling Water System Program" is comprised of the Chemistry Program (B.1.2) and the Cooling Water Corrosion Program (B.2.2).* *4. For FCS, MIC and galvanic corrosion are also AERMs for this material and environment.*
3.2.1.10	Pumps, valves, piping, and fittings in containment spray and emergency core cooling systems	Crack initiation and growth due to SCC	Water chemistry	No	1. The aging management results are consistent with the results documented in NUREG-1801. 2. Consistent with NUREG-1801, this group includes stainless steel and stainless steel clad carbon steel in chemically treated borated water at FCS.
3.2.1.11	Carbon steel components	Loss of material due to boric acid corrosion	Boric acid corrosion	No	1. The aging management results are consistent with the results documented in NUREG-1801. 2. Consistent with NUREG-1801, this group includes carbon and low alloy steel at FCS.

TABLE 3.2-1
Summary of Aging Management Programs for Engineered Safety Features Evaluated in NUREG-1801 that are Relied on for FCS License Renewal

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.2.1.12	Closure bolting in high pressure or high temperature systems	Loss of material due to general corrosion, loss of preload due to stress relaxation, and crack initiation and growth due to cyclic loading or SCC	Bolting integrity	No	1. The aging management results are consistent with the results documented in NUREG-1801. 2. Consistent with NUREG-1801, this group includes carbon and low alloy steel in ambient air at FCS.

Red & Italics – Review based changes
Blue & Bold – RAI based changes

TABLE 3.2-2
FCS Engineered Safety Features Component Types Subject To Aging Management Review Not Evaluated in NUREG-1801

Row Number	Component Types	Material	Environment	AERMs	Program/Activity
3.2.2.01	Heat Exchanger - Tubes	Alloy 600	Chemically Treated Borated Water	Loss of Material Crevice corrosion in the presence of sufficient levels of oxygen, halogens, sulfates, or copper	Chemistry Program (B.1.2)
3.2.2.02	Heat Exchanger - Tubes	Alloy 600	Chemically Treated Borated Water	Cracking Stress Corrosion Cracking due to exposure to halogens or sulfates	Chemistry Program (B.1.2)
3.2.2 03	Heat Exchanger - Tubes	Alloy 600	Corrosion-Inhibited Treated Water	Loss of Material • Crevice and pitting corrosion in the presence of sufficient levels of oxygen, halogens, or sulfates • MIC due to exposure to microbiological activity	Chemistry Program (B.1.2) and Cooling Water Corrosion Program (B.2.3)
3.2.2.04	~~*External surface of*~~ ~~s~~Stainless steel components~~*s surfaces*~~	Stainless Steel	Ambient Air	None	Not Applicable
3.2.2.05	Filter/Strainers	Galvanized Steel	Containment Air	Loss of Material • Crevice corrosion where crevices exist that allow a corrosive environment to develop • General corrosion where both oxygen and moisture are present	Periodic Surveillance and Preventive Maintenance Program
3.2.2.06	Heat Exchanger - Shell	Cast Iron	Corrosion-Inhibited Treated Water	Loss of Material Selective leaching due to the exposure of cast iron to dissolved oxygen	Selective Leaching Program

TABLE 3.2-2
FCS Engineered Safety Features Component Types Subject To Aging Management Review Not Evaluated in NUREG-1801

Row Number	Component Types	Material	Environment	AERMs	Program/Activity
3.2.2.07	Valve, Pipes & Fittings	Carbon Steel	Dry Air/Gas	None	Not Applicable

Red & Italics – Review based changes
Blue & Bold – RAI based changes (NONE)

Table 3.3-1
Summary of Aging Management Programs for Auxiliary Systems Evaluated in NUREG-1801 that are Relied on for FCS License Renewal

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1.01	Components in spent fuel pool cooling and cleanup	Loss of material due to general, pitting, and crevice corrosion	Water chemistry and one-time inspection	Yes, detection of aging effects is to be further evaluated	The material identified in NUREG-1801 is not applicable to FCS. These components are addressed in Section 3.3.2 of this application.
3.3.1.02	Linings in spent fuel pool cooling and cleanup system; seals and collars in ventilation systems	Hardening, cracking and loss of strength due to elastomer degradation; loss of material due to wear	Plant specific	Yes, plant specific	1. The FCS aging management review results are consistent with those reviewed and approved NUREG-1801. 2. The General Corrosion of External Surfaces Program (B.3.3) **and the Periodic Surveillance and Preventive Maintenance Program (B.2.7)**[32] manages this aging effect. This program is described in Appendix B of this application. 3. Consistent with NUREG-1801, this group only includes elastomer seals in the ventilation systems exposed to ambient air at FCS.
3.3.1.03	Components in load handling, chemical and volume control system (PWR), and reactor water cleanup and shutdown cooling systems (older BWR)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801 for the chemical and volume control and primary sampling systems. 2. The metal fatigue time limited aging analyses are discussed in Section 4.3.1 of this application.

[32] **RAI # 3.3.1-1**

Table 3.3-1
Summary of Aging Management Programs for Auxiliary Systems Evaluated in NUREG-1801 that are Relied on for FCS License Renewal

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1.04	Heat exchangers in reactor water cleanup system (BWR); high pressure pumps in chemical and volume control system (PWR)	Crack initiation and growth due to SCC or cracking	Plant specific	Yes, plant specific	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801. 2. The Chemistry (B.1.2) and One-Time Inspection Programs (B.3.5) manage this aging effect. One-Time Inspection will be conducted prior to the period of extended operation to confirm the effectiveness of the Chemistry Program. These programs are described in Appendix B of this application. 3. Consistent with NUREG-1801, this group includes stainless steel in chemically treated borated water at FCS.
3.3.1.05	Components in ventilation systems, diesel fuel oil system, and emergency diesel generator systems; external surfaces of carbon steel components	Loss of material due to general, pitting, and crevice corrosion, and MIC	Plant specific	Yes, plant specific	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801. 2. The Periodic Surveillance and Preventive Maintenance (B.2.7), General Corrosion of External Surfaces (B.3.3), *Cooling Water Corrosion Program (B.2.2),* and Fire Protection Programs (B.2.5) manage this aging effect. These programs are described in Appendix B of this application. The FCS Fire Protection Program provides guidance for detecting loss of material due to general, pitting, crevice, and microbiologically influenced corrosion (MIC). 3. Consistent with NUREG-1801, this group includes carbon steel, galvanized steel, and copper in air, and carbon steel in diesel engine exhaust gases at FCS.

Table 3.3-1
Summary of Aging Management Programs for Auxiliary Systems Evaluated in NUREG-1801 that are Relied on for FCS License Renewal

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1.06	Components in reactor coolant pump oil collect system of fire protection	Loss of material due to galvanic, general, pitting, and crevice corrosion	One-time inspection	Yes, detection of aging effects is to be further evaluated	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801. 2. The One-Time Inspection Program (B.3.5) manages this aging effect. These inspections will be conducted prior to the period of extended operation. These programs are described in Appendix B of this application. 3. Consistent with NUREG-1801, this group includes copper in lubricating oil at FCS.
3.3.1.07	Diesel fuel oil tanks in diesel fuel oil system and emergency diesel generator system	Loss of material due to general, pitting, and crevice corrosion, MIC, and biofouling	Fuel oil chemistry and one-time inspection	Yes, detection of aging effects is to be further evaluated	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801. 2. The Diesel Fuel Monitoring and Storage Program (B.2.3) manages this aging effect. This program is described in Appendix B of this application. Diesel Fuel Monitoring and Storage Program includes the Fuel Oil Chemistry Program at FCS. The Diesel Fuel Monitoring and Storage Program includes measures to verify the effectiveness of the fuel oil chemistry control. These inspections will be conducted prior to the period of extended operation to confirm the effectiveness of the oil chemistry control. 3, Consistent with NUREG-1801 this group includes carbon steel in fuel oil at FCS.

Table 3.3-1
Summary of Aging Management Programs for Auxiliary Systems Evaluated in NUREG-1801 that are Relied on for FCS License Renewal

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1.08	Heat exchangers in chemical and volume control system	Crack initiation and growth due to SCC and cyclic loading	Water chemistry and a plant-specific verification program	Yes, plant specific	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801. 2. The Chemistry Program (B.1.2) verified by the ~~*One-Time Inspection Program (B.3.5),*~~ Cooling Water Corrosion Program (B.2.2) and *In-Service Inspection Program (B.1.6)* ~~*Periodic Surveillance and Preventive Maintenance Program (B.2.7)*~~ manage this aging effect Inspections will be conducted prior to the period of extended operation to confirm the effectiveness the Chemistry Program. These programs are described in Appendix B of this application. 3. Consistent with NUREG-1801 this group includes stainless steel in chemically treated borated and corrosion inhibited treated water at FCS.
3.3.1.09	Neutron absorbing sheets in spent fuel storage racks	Reduction of neutron absorbing capacity and loss of material due to general corrosion (Boral, boron steel)	Plant specific	Yes, plant specific	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801. 2. The Periodic Surveillance and Preventive Maintenance Program (B.2.7) manages this aging effect. This program is described in Appendix B of this application. The surveillance test evaluates the neutron absorbing samples for dimensional change, weight change, neutron attenuation change and specific gravity change. 3. Consistent with NUREG-1801 this group includes Boral encapsulated in stainless steel in chemically treated borated water at FCS.

Table 3.3-1
Summary of Aging Management Programs for Auxiliary Systems Evaluated in NUREG-1801 that are Relied on for FCS License Renewal

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1.10	New fuel rack assembly	Loss of material due to general, pitting, and crevice corrosion	Structures monitoring	No	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801. 2. Consistent with NUREG-1801 this group includes carbon steel in ambient air at FCS.
3.3.1.11	Spent fuel storage racks and valves in spent fuel pool cooling and cleanup	Crack initiation and growth due to stress corrosion cracking	Water chemistry	No	1. The aging management results are consistent with those reviewed and approved in NUREG-1801. 2. Consistent with NUREG-1801, this group includes stainless steel in borated treated water at FCS.
3.3.1.12	Neutron absorbing sheets in spent fuel storage racks	Reduction of neutron absorbing capacity due to Boraflex degradation	Boraflex monitoring	No	The material identified in NUREG-1801 is not applicable to FCS.
3.3.1.13	Closure bolting and external surfaces of carbon steel and low-alloy steel components	Loss of material due to boric acid corrosion	Boric acid corrosion	No	1. The aging management results are consistent with those reviewed and approved in NUREG-1801. 2. Consistent with NUREG-1801, this group includes carbon and low alloy steel in air exposed to leaking and dripping borated treated water at FCS.
3.3.1.14	Components in or serviced by closed-cycle cooling water system	Loss of material due to general, pitting, and crevice corrosion, and MIC	Closed-cycle cooling water system	No	1. The aging management results are consistent with those reviewed and approved in NUREG-1801. 2. Consistent with NUREG-1801 this group includes carbon steel, *cast iron,* and stainless steel in chemically treated corrosion inhibited water at FCS. *The Chemistry Program (B.1.2) is also credited at FCS since the necessary elements are not included in the Cooling Water Corrosion Program (B.2.2).*
3.3.1.15	Cranes including bridge and trolleys and rail system in load handling system	Loss of material due to general corrosion and wear	Overhead heavy load and light load handling systems	No	1. The aging management results are consistent with those reviewed and approved in NUREG-1801. 2. Consistent with NUREG-1801 this group includes carbon steel in ambient air at FCS.

Table 3.3-1
Summary of Aging Management Programs for Auxiliary Systems Evaluated in NUREG-1801 that are Relied on for FCS License Renewal

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1.16	Components in or serviced by open-cycle cooling water systems	Loss of material due to general, pitting, crevice, and galvanic corrosion, MIC, and biofouling; buildup of deposit due to biofouling	Open-cycle cooling water system	No	1. The aging management results are consistent with the results documented in NUREG-1801. 2. Consistent with NUREG-1801 this group includes carbon steel, bronze, cast iron and stainless steel in raw water at FCS.
3.3.1.17	Buried piping and fittings	Loss of material due to general, pitting, and crevice corrosion, and MIC	Buried piping and tanks surveillance or Buried piping and tanks inspection	No Yes, detection of aging effects and operating experience are to be further evaluated	1. The aging management results are consistent with the results documented in NUREG-1801. 2. The aging effects are managed by the Buried Surfaces External Corrosion Program (B.3.2) and the Fire Protection Program (B.2.5) described in Appendix B of this application. The aging management activities of the Fire Protection Program are the same as those of the Buried Surfaces External Corrosion Program. 3. Consistent with NUREG-1801 this group includes carbon steel in soil at FCS.
3.3.1.18	Components in compressed air system	Loss of material due to general and pitting corrosion	Compressed air monitoring	No	The environment identified in NUREG-1801 is not applicable to FCS. Components in the instrument air system at FCS are exposed to dry air.
3.3.1.19	Components (doors and barrier penetration seals) and concrete structures in fire protection	Loss of material due to wear; hardening and shrinkage due to weathering	Fire protection	No	1. The aging management results are consistent with those reviewed and approved in NUREG-1801. 2. Consistent with NUREG-1801 this group includes carbon steel and sealant in ambient air at FCS.
3.3.1.20	Components in water-based fire protection	Loss of material due to general, pitting, crevice, and galvanic corrosion, MIC, and biofouling	Fire water system	No	1. The aging management results are consistent with those reviewed and approved in NUREG-1801. 2. Consistent with NUREG-1801 this group includes carbon steel, cast iron, stainless steel, and bronze in raw water **and potable water**[33] at FCS.

[33] **RAI # 2.3.3.14-2**

Table 3.3-1
Summary of Aging Management Programs for Auxiliary Systems Evaluated in NUREG-1801 that are Relied on for FCS License Renewal

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1.21	Components in diesel fire system	Loss of material due to galvanic, general, pitting, and crevice corrosion	Fire protection and fuel oil chemistry	No	1. The aging management results are consistent with those reviewed and approved in NUREG-1801. 2. Consistent with NUREG-1801 this group includes carbon steel in fuel oil at FCS.
3.3.1.22	Tanks in diesel fuel oil system	Loss of material due to general, pitting, and crevice corrosion	Above ground carbon steel tanks	No	The components identified in NUREG-1801 are not applicable to FCS.
3.3.1.23	Closure bolting	Loss of material due to general corrosion; crack initiation and growth due to cyclic loading and SCC	Bolting integrity	No	1. The aging management results are consistent with those reviewed and approved in NUREG-1801. 2. Consistent with NUREG-1801 this group includes carbon steel and low alloy steel in ambient air at FCS.
3.3.1.24	Components (aluminum bronze, brass, cast iron, cast steel) in open-cycle and closed-cycle cooling water systems, and ultimate heat sink	Loss of material due to selective leaching	Selective leaching of materials	No	1. The aging management results are consistent with those reviewed and approved in NUREG-1801. ~~2. Consistent with NUREG-1801, this group includes cast iron and bronze in raw water and soil at FCS.~~

Table 3.3-1
Summary of Aging Management Programs for Auxiliary Systems Evaluated in NUREG-1801 that are Relied on for FCS License Renewal

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1.25	Fire barriers, walls, ceilings and floors in fire protection	Concrete cracking and spalling due to freeze-thaw, aggressive chemical attack, and reaction with aggregates; loss of material due to corrosion of embedded steel	Fire protection and structures monitoring	No	1. The aging management results are consistent with the results documented in NUREG-1801. 2. Consistent with NUREG-1801 this group includes concrete in ambient air at FCS.

Red & Italics – Review based changes
Blue & Bold – RAI based changes

Table 3.3-2
Fort Calhoun Auxiliary Systems Component Types Subject to Aging Management
Not Evaluated in NUREG-1801

Row Number	Component Types	Material	Environment	AERMs	Program/Activity
3.3.2.01	*Internal and* external surfaces of aluminum components	Aluminum	Ambient Air	None	Not Applicable
3.3.2.02	Filter/strainer housing, Valve bodies	Aluminum	Fuel Oil	Loss of Material • MIC due to the potential for microorganism introduction and moisture contamination during bulk fuel oil supply and delivery. • Pitting/Crevice/General Corrosion due to potential for water contamination and water pooling in a fuel oil system	Diesel Fuel Monitoring and Storage Program (B.2.3)
3.3.2.03	**~~Not used in application~~ Valve bodies**	**Bronze**	**Oxygenated Treated Water <200 F**	**Loss of Material Crevice and pitting corrosion**	**Fire Protection Program (B.2.5)[34]**
3.3.2.04	Filter/strainer housing, Valve Operators, Valve bodies	Aluminum	Instrument Air	None	Not Applicable
3.3.2.05	Valve bodies	Aluminum	Gas - Nitrogen	None	Not Applicable

[34] **RAI # 2.3.3.14-2**

Table 3.3-2
Fort Calhoun Auxiliary Systems Component Types Subject to Aging Management Not Evaluated in NUREG-1801

Row Number	Component Types	Material	Environment	AERMs	Program/Activity
3.3.2.06	Switch/bistable housing	Aluminum	Raw Water	Loss of Material Crevice and pitting corrosion and MIC due to stagnant conditions	Fire Protection Program (B.2.5)
3.3.2.07	New and spent fuel handling tools	Aluminum	Occasionally exposed to Treated Water - Borated	Cracking • Due to stress corrosion cracking (SCC) due to the exposure of aluminum to halogens and stress.	Chemistry Program (B.1.2)
3.3.2.08	New and spent fuel handling tools	Aluminum	Occasionally exposed to Treated Water - Borated	Loss of Material • Pitting corrosion due to the exposure of aluminum to halogens and sulfates • Galvanic corrosion due to aluminum in contact with stainless steel and exposed to halogens • Exfoliation due to the exposure of aluminum to halogens	Chemistry Program (B.1.2)
3.3.2.09	Subcomponent - new fuel storage rack -boral sheets	Boral	Ambient Air	None	Not Applicable
3.3.2.10	~~*External surfaces of b*~~ *B*rass or bronze component*s surfaces*	Brass or Bronze	Ambient Air	None	Not Applicable

Table 3.3-2
Fort Calhoun Auxiliary Systems Component Types Subject to Aging Management Not Evaluated in NUREG-1801

Row Number	Component Types	Material	Environment	AERMs	Program/Activity
3.3.2.11	Valve bodies, filters/strainer housing, pump casings	Brass or Bronze	Fuel Oil	Loss of Material • MIC due to the potential for microorganism introduction and moisture contamination during bulk fuel oil supply and delivery. • Pitting/Crevice/General Corrosion due to potential for water contamination and water pooling in a fuel oil system	Diesel Fuel Monitoring and Storage Program (B.2.3)
3.3.2.12	Valve bodies	Brass	Gas - Halon	None	Not Applicable
3.3.2.13	Valve bodies	Brass or Bronze	Gas - Instrument Air	None	Not Applicable
3.3.2.14	Valve bodies	Brass or Bronze	Gas - Nitrogen	None	Not Applicable
3.3.2.15	Valve bodies	Brass	Gas - Refrigerant (Liquid)	None	Not Applicable

Table 3.3-2
Fort Calhoun Auxiliary Systems Component Types Subject to Aging Management Not Evaluated in NUREG-1801

Row Number	Component Types	Material	Environment	AERMs	Program/Activity
3.3.2.16	Heat exchanger	Brass or Bronze	Lubricating Oil	Loss of Material *Pitting/Crevice/*General corrosion due to the possibility for water contamination and water pooling.	~~*Cooling Water Corrosion Program (B.2.2)*~~ *Periodic Surveillance and Preventive Maintenance Program (B.2.7)*
3.3.2.17	Heat exchanger, **pipes and fittings**[35]	Brass	Corrosion-Inhibited Treated Water	Cracking Due to SCC because of the ammonium compounds present in the water due to the nitrite corrosion inhibitor	Cooling Water Corrosion Program (B.2.2) and Chemistry Program (B.1.2)
3.3.2.18	Heat exchanger, **pipes and fittings**[31]	Brass, Copper Alloy	Corrosion-Inhibited Treated Water	Loss of Material • Crevice and pitting corrosion due to potential stagnant or low flow conditions. • Galvanic corrosion due to the high conductivity of the process fluid and the presence of dissimilar metals in contact. • MIC due to the exposure of copper alloy to microbiological activity	Cooling Water Corrosion Program (B.2.2) and Chemistry Program (B.1.2)

[35] RAI # 3.2-1

Table 3.3-2
Fort Calhoun Auxiliary Systems Component Types Subject to Aging Management Not Evaluated in NUREG-1801

Row Number	Component Types	Material	Environment	AERMs	Program/Activity
3.3.2.19	Switch/bistable housing	Brass	Raw Water	Loss of Material • Crevice and pitting corrosion and MIC due to stagnant conditions • Galvanic corrosion due to the conductivity of the process fluid and the presence of dissimilar metals in contact.	Fire Protection Program (B.2.5)
3.3.2.20	Valve bodies	Cadmium Plated Steel	Gas - Instrument Air	None	Not Applicable
3.3.2.21	Pipes & fittings, **tanks**[36]	Carbon Steel, *coated carbon steel*	Above ground, buried in gravel and protected from the elements	Loss of Material Due to external surface corrosion due to the potential for the existence of sufficient oxygen, moisture levels, and/or soil contaminants	Diesel Fuel Monitoring and Storage Program (B.2.3)
3.3.2.22	Pipes & fittings	Carbon Steel	Concrete	None	Not Applicable
3.3.2.23	*Bus duct*, filter strainer housing, heat exchangers, lubricator motors, pipes & fittings, tanks, valve bodies, accumulators, valve operators	Carbon Steel	Gas - Instrument Air	None	Not Applicable

[36] **RAI # 3.3.2-7**

Table 3.3-2
Fort Calhoun Auxiliary Systems Component Types Subject to Aging Management Not Evaluated in NUREG-1801

Row Number	Component Types	Material	Environment	AERMs	Program/Activity
3.3.2.24	Pipes and fittings	Carbon Steel	Gas - Hydrogen	None	Not Applicable
3.3.2.25	Valve bodies, accumulators, pipes & fittings	Carbon Steel	Gas - Nitrogen	None	Not Applicable
3.3.2.26	Pipes & fittings, valves	~~*Carbon Steel or*~~ Cast Iron	Concrete	None	Not Applicable
3.3.2.27	Heat exchanger – shell, **pipes & fittings, pump casings**[37]	Carbon Steel, **Cast Iron**[33]	Oxygenated Treated Water <200F	Loss of Material • General and crevice corrosion due to dissolved oxygen • Pitting corrosion due to halogens • Galvanic corrosion due to the conductivity of the process fluid and the presence of dissimilar metals in contact.	Chemistry Program (B.1.2), ~~and~~ Cooling Water Corrosion Program (B.2.2), **and Fire Protection Program (B.2-5)**[33]
3.3.2.28	Valve bodies	Cast Iron	Gas - Refrigerant (Liquid)	None	Not Applicable

[37] **RAI # 2.3.3.14-2**

Table 3.3-2
Fort Calhoun Auxiliary Systems Component Types Subject to Aging Management Not Evaluated in NUREG-1801

Row Number	Component Types	Material	Environment	AERMs	Program/Activity
3.3.2.29	Pump casings, valve bodies, pipes & fittings, heat exchanger - channel/channel head	Cast Iron	Corrosion-Inhibited Treated Water	Loss of Material • General and crevice corrosion due to the exposure of cast iron to dissolved oxygen • Pitting corrosion due to exposure to halogens	Chemistry Program (B.1.2) and Cooling Water Corrosion Program (B.2.2)
3.3.2.30	Pump casings, valve bodies, pipes & fittings, *heat exchanger – channel/channel head*	Cast Iron, **Bronze**[33]	Corrosion-Inhibited Treated Water, **Oxygenated Treated Water <200F**[33]	Loss of Material Selective leaching due to the exposure of cast iron to dissolved oxygen	Selective Leaching Program (B.3.6)
3.3.2.31	Valve bodies, pipes & fittings	Cast Iron	Buried in Ground	Loss of Material • General corrosion due to exposure to dissolved oxygen • Selective leaching due to the exposure of cast iron to dissolved oxygen	Fire Protection Program governs implementing procedures that provide reasonable assurance the Fire Protection System pressure-retaining components will be adequately managed by specific performance and/or condition monitoring activities in accordance with the Current Licensing Basis requirements.Fire Protection Program

Table 3.3-2
Fort Calhoun Auxiliary Systems Component Types Subject to Aging Management Not Evaluated in NUREG-1801

Row Number	Component Types	Material	Environment	AERMs	Program/Activity
3.3.2.32	Tanks, pipes & fittings, filter/strainers, valves	Coated Carbon Steel, Cast Iron, Stainless Steel, Galvanized Steel	Fuel Oil	Loss of Material • MIC due to the potential for microorganism introduction and moisture contamination during bulk fuel oil supply and delivery. • Pitting/Crevice/General Corrosion due to potential for water contamination and water pooling in a fuel oil system	Diesel Fuel Monitoring and Storage Program (B.2.3)
3.3.2.33	Pressure vessels	Coated Carbon Steel	Gas - Halon (Liquid)	None	Not Applicable
3.3.2.34	Pipes & fittings	Concrete	Buried in Ground	None	Not Applicable
3.3.2.35	Pipes & fittings	Concrete	Raw Water	None	Not Applicable
3.3.2.36	Safety Injection Refueling Water Tank (SIRWT)	Concrete with coated carbon steel liner	Treated Water - Borated	Loss of Material Due to exposure of the material to moisture, contaminants, dissolved oxygen, and boric acid (i.e., general corrosion, crevice corrosion, pitting corrosion, boric acid corrosion and galvanic corrosion)	Structures Monitoring Program (B.2.10)

Table 3.3-2
Fort Calhoun Auxiliary Systems Component Types Subject to Aging Management Not Evaluated in NUREG-1801

Row Number	Component Types	Material	Environment	AERMs	Program/Activity
3.3.2.37	Pipes & fittings, tubing, *valve bodies*	Copper, Copper Alloy, Copper-Zinc Alloy	Gas - Instrument Air	None	Not Applicable
3.3.2.38	Valve bodies, pipes & fittings, heat exchanger tubes	Copper, Copper Alloy	Gas – Refrigerant *(liquid)*	None	Not Applicable
3.3.2.39	Heat exchangers, valves	Brass, Copper, Copper alloy	Corrosion-Inhibited Treated Water	Loss of Material • Crevice and pitting corrosion due to potential stagnant or low flow conditions. • Galvanic corrosion due to the high conductivity of the process fluid and the presence of dissimilar metals in contact. • MIC due to the exposure of copper alloy to microbiological activity	Chemistry Program (B.1.2) and Cooling Water Corrosion Program (B.2.2)
3.3.2.40	External surfaces of brass, bronze, copper, copper alloy or copper-zinc alloy components	Brass, Bronze, Copper, Copper Alloy, Copper-Zinc Alloy	Ambient Air	None	Not Applicable

Table 3.3-2
Fort Calhoun Auxiliary Systems Component Types Subject to Aging Management Not Evaluated in NUREG-1801

Row Number	Component Types	Material	Environment	AERMs	Program/Activity
3.3.2.41	Heat exchangers, valves	Copper Alloy	Corrosion-Inhibited Treated Water	Cracking Due to SCC because of the ammonium compounds present in the water due to the nitrite corrosion inhibitor	Chemistry Program (B.1.2) and Cooling Water Corrosion Program (B.2.2)
3.3.2.42	Tubing	Copper-Zinc Alloy	Buried in Ground	Loss of Material Due to general and pitting corrosion due to the potential for the existence of sufficient oxygen, moisture levels, and/or soil contaminants	Buried Services External Corrosion Program (B.3.2)
3.3.2.43	Tubing	Copper-Zinc Alloy	Buried in Ground	Loss of Material Due to dezincification	Selective Leaching Program (B.3.6)
3.3.2.44	Tubing	Copper-Zinc Alloy	Above ground, buried in gravel and protected from the elements	Loss of Material Due to general and pitting corrosion due to the potential for the existence of sufficient oxygen, moisture levels, and/or soil contaminants	Diesel Fuel Monitoring and Storage Program (B.2.3)

Table 3.3-2
Fort Calhoun Auxiliary Systems Component Types Subject to Aging Management Not Evaluated in NUREG-1801

Row Number	Component Types	Material	Environment	AERMs	Program/Activity
3.3.2.45	Tubing	Copper-Zinc Alloy, *copper alloy*	Fuel Oil	Loss of Material • MIC due to the potential for microorganism introduction and moisture contamination during bulk fuel oil supply and delivery. • Pitting/Crevice/General Corrosion due to potential for water contamination and water pooling in a fuel oil system	Diesel Fuel Monitoring and Storage Program (B.2.3)

Table 3.3-2
Fort Calhoun Auxiliary Systems Component Types Subject to Aging Management Not Evaluated in NUREG-1801

Row Number	Component Types	Material	Environment	AERMs	Program/Activity
3.3.2.46	Pipes & fittings	Galvanized Steel	Gas - Diesel Exhaust	Cracking Due to embrittlement at elevated temperatures. Loss of Material • Crevice corrosion due to the presence of an aggressive chemical species and moisture • Pitting corrosion due to halides, chlorides or hypochlorites	Periodic Surveillance and Preventive Maintenance Program (B.2.7)
3.3.2.47	Pipes & fittings	Galvanized Steel	Above ground, buried in gravel and protected from the elements, **or below grade**[38]	Loss of Material Due to general and pitting corrosion due to the potential for the existence of sufficient oxygen, moisture levels, and/or soil contaminants	Diesel Fuel Monitoring and Storage Program (B.2.3), **or Fire Protection Program (B.2.5)**[34]
3.3.2.48	External surfaces of galvanized steel components	Galvanized Steel	Ambient Air	Loss of Material • Crevice corrosion due to crevices existing that allow a corrosive environment to develop. • General corrosion due to presence of both oxygen and moisture.	General Corrosion of Ext. Surfaces Program (B.3.3) Fire Protection Program (B.2.5)

[38] **RAI # 2.3.3.14-2**

Table 3.3-2
Fort Calhoun Auxiliary Systems Component Types Subject to Aging Management Not Evaluated in NUREG-1801

Row Number	Component Types	Material	Environment	AERMs	Program/Activity
3.3.2.49	Sight Glass	Glass	Fuel Oil, Lubricating Oil, Corrosion-Inhibited Treated Water, Air	None	Not Applicable
3.3.2.50	Flow element/orifice body, pipes & fittings, pump casings, valve bodies, *tanks*	Heat-Traced Stainless Steel	Plant Indoor Air	Cracking Due to possible leachables in heat-tracing adhesive (cement) combined with component temperatures exceeding 160 deg F due to the heat tracing.	One Time Inspection Program (B.3.5)
3.3.2.51	Fire barriers	Mineral Fiber	Ambient Air	Separation Due to vibration, movement, and shrinkage	Fire Protection Program (B.2.5)
3.3.2.52	Fire barriers	Mineral Fiber Board	Ambient Air	Cracking Due to vibration and movement	Fire Protection Program (B.2.5)
3.3.2.53	Fire barriers	Mineral Fiber Board	Ambient Air	Loss of Material Due to abrasion	Fire Protection Program (B.2.5)
3.3.2.54	Fire barriers	Mineral Fiber Board	Ambient Air	Separation Due to vibration, movement, and shrinkage	Fire Protection Program (B.2.5)
3.3.2.55	Heat exchanger - tubes, heat exchanger - shell	Nickel-Base Alloy	Deoxygenated Treated Water (>200F)	Cracking Stress Corrosion Cracking d potential exposure to haloge	Chemistry Program (B.1.2) and Cooling Water Corrosion Program (B.2.2)

Table 3.3-2
Fort Calhoun Auxiliary Systems Component Types Subject to Aging Management Not Evaluated in NUREG-1801

Row Number	Component Types	Material	Environment	AERMs	Program/Activity
3.3.2.56	Heat exchanger - tubes, heat exchanger - shell	Nickel-Base Alloy	Deoxygenated Treated Water (>200F)	Loss of Material • Crevice corrosion due to exposure to dissolved ox • MIC due to the potential microbiological activity • Pitting corrosion due to p exposure to halogens an	Chemistry Program (B.1.2) and Cooling Water Corrosion Program (B.2.2) ~~and One Time Inspection Program (B.3.5)~~
3.3.2.57	Heat exchanger - tubes, Heat exchanger - shell	Copper Alloy, Nickel-Base Alloy	Corrosion-Inhibited Treated Water	Loss of Material Crevice and pitting corrosion due to the exposure of nickel-based alloys to halogens and sulfates.	Chemistry Program (B.1.2) and Cooling Water Corrosion Program (B.2.2)
3.3.2.58	Heat exchanger - shell	Nickel-Base Alloy	Plant Indoor Air	None	Not Applicable
3.3.2.59	Fire barriers	Pyrocrete	Ambient Air	Cracking Due to vibration, movement, and shrinkage	Fire Protection Program (B.2.5)
3.3.2.60	Fire barriers	Pyrocrete	Ambient Air	Loss of Material • Due to vibration that may cause delamination • Due to movement that may cause separation	Fire Protection Program (B.2.5)
3.3.2.61	Fire barriers	Pyrocrete	Ambient Air	Separation • Due to contact with pipe surfaces • Due to hydration	Fire Protection Program (B.2.5)
3.3.2.62	Indicator/recorder body	Polysulfone	Plant Indoor Air	None	Not Applicable

Table 3.3-2
Fort Calhoun Auxiliary Systems Component Types Subject to Aging Management Not Evaluated in NUREG-1801

Row Number	Component Types	Material	Environment	AERMs	Program/Activity
3.3.2.63	Indicator/recorder body	Polysulfone	Raw Water	None	Not Applicable
3.3.2.64	*Not used in application.*				
3.3.2.65	Pipes & fittings	Stainless Steel	Concrete	None	Not Applicable
3.3.2.66	Pipes & fittings, valve bodies	Stainless Steel	Deoxygenated Treated Water (>200F)	Cracking Due to exposure of stainless steel to halogens and sulfates.	Chemistry Program (B.1.2), One Time Inspection Program (B.3.5)
3.3.2.67	Pipes & fittings, valve bodies	Stainless Steel	Deoxygenated Treated Water (>200F)	Loss of Material • Crevice corrosion due exposure of stainless steel to dissolved oxygen • Pitting corrosion due to the exposure of stainless steel to halogens and sulfates	Chemistry Program (B.1.2), One Time Inspection Program (B.3.5)

Table 3.3-2
Fort Calhoun Auxiliary Systems Component Types Subject to Aging Management Not Evaluated in NUREG-1801

Row Number	Component Types	Material	Environment	AERMs	Program/Activity
3.3.2.68	Filter strainer housing, valve bodies, tubing	Stainless Steel	Fuel Oil	Loss of Material • MIC due to the potential for microorganism introduction and moisture contamination during bulk fuel oil supply and delivery. • Pitting/Crevice/General Corrosion due to potential for water contamination and water pooling in a fuel oil system	Diesel Fuel Monitoring and Storage Program (B.2.7)
3.3.2.69	Pipes & fittings	Stainless Steel	Gas - Diesel Exhaust	Cracking Due to moisture-containing contaminants concentrate, resulting in an environment conducive to SCC/IGA. Loss of Material • Crevice corrosion due to the presence of an aggressive chemical species and moisture • Pitting corrosion due to halides, chlorides or hypochlorites	Periodic Surveillance and Preventive Maintenance Program (B.2.7)
3.3.2.70	*Pipes & fittings,* valve bodies	Stainless Steel	Gas - Hydrogen	None	Not Applicable

Table 3.3-2
Fort Calhoun Auxiliary Systems Component Types Subject to Aging Management Not Evaluated in NUREG-1801

Row Number	Component Types	Material	Environment	AERMs	Program/Activity
3.3.2.71	Pipes & fittings, valve bodies, tubing	Stainless Steel	Gas - Instrument Air	None	Not Applicable
3.3.2.72	Pipes & fittings, valve bodies, tubing	Stainless Steel	Gas - Nitrogen	None	Not Applicable
3.3.2.73	Pipes & fittings, valve bodies, piping spray shield, **tanks**[39]	Stainless Steel	Lubricating Oil	Loss of Material ~~General corrosion~~[35] due to the possibility for water contamination and water pooling.	~~Fire Protection Program (B.2.5)~~ **One-Time Inspection Program (B.3.5)** [35]
3.3.2.74	Flow element/orifice body, indicator/recorder housing, orifice plate, pipes & fittings, valve bodies, heat exchanger ~~–tubes~~, **RCP pump cover, RCP seal water cooler tubes**[40]	Stainless Steel	Corrosion-Inhibited Treated Water	Cracking Due to exposure to halogens and sulfates.	Chemistry Program (B.1.2) and Cooling Water Corrosion Program (B.2.2)
3.3.2.75	External surfaces of stainless steel *components*	Stainless Steel	Ambient Air	None	Not Applicable
3.3.2.76	Heat exchanger – tubes, **valve bodies,**[41] **pipes & fittings**[42]	Stainless Steel	Oxygenated Treated Water <200F	Loss of Material • Crevice corrosion due to an oxygenated treated water environment • Pitting corrosion due to exposure to halogens and sulfates.	Chemistry Program (B.1.2) and Cooling Water Corrosion Program (B.2.2)

[39] **RAI # 2.3.1.2-3**
[40] **RAI # 3.1-1**
[41] **RAI # 3.3.2-7**

Table 3.3-2
Fort Calhoun Auxiliary Systems Component Types Subject to Aging Management Not Evaluated in NUREG-1801

Row Number	Component Types	Material	Environment	AERMs	Program/Activity
3.3.2.77	**Not used in application.**[43]				
3.3.2.78	**Piping & fittings, valve bodies**[44]	**Carbon Steel**	**Compressed Air**	**Loss of Material**	**Periodic Surveillance and Preventive Maintenance Program (B.2.7)**
3.3.2.79	Glass in metal fire penetration barriers	Glass	Ambient Air	None	Not Applicable
3.3.2.80	Calcium silicate board	Calcium Silicate	Ambient Air	None	Not Applicable
3.3.2.81	Fuel transfer carrier box, fuel transfer conveyor, UGS lift rig, reactor head lift rig, fuel handling tools, fuel transfer tilting machine, spent fuel storage racks	Stainless Steel	Ambient Air and Borated Water	Loss of Material • Crevice corrosion due to the exposure to dissolved oxygen. • Pitting corrosion due to the exposure to halogens and sulfates.	Chemistry Program (B.1.2)
3.3.2.82	Valve bonnets protected by rubber diaphragm	Ductile Iron	Possibly exposed to borated water	Loss of material due to boric acid corrosion	Periodic Surveillance and Preventive Maintenance Program (B.2.7)
3.3.2.83	Pipes & fittings	Galvanized Steel	Ambient Air	Loss of material • General corrosion due to exposure to oxygen and moisture • Crevice corrosion due to exposure to moisture	Periodic Surveillance and Preventive Maintenance Program (B.2.7)

[42] **POI-01(a)**
[43] **RAI # 3.3.2-1**
[44] **RAI # 2.3.3.8-1**

Table 3.3-2
Fort Calhoun Auxiliary Systems Component Types Subject to Aging Management Not Evaluated in NUREG-1801

Row Number	Component Types	Material	Environment	AERMs	Program/Activity
3.3.2.84	Heat exchanger tubes, valve bodies	Copper Alloy, *Brass*	Corrosion-Inhibited Treated Water	Loss of material Due to selective leaching	Selective Leaching Program (B.3.6)
3.3.2.85	Heat exchanger tubes, valves, **filters/strainers**[45]	Copper Alloy, Brass, Bronze	Lubricating Oil	Loss of Material Pitting, general and crevice corrosion due to potential for water contamination	Periodic Surveillance and Preventive Maintenance Program (B.2.7)
3.3.2.86	Pipes & fittings, tanks	Coated Carbon Steel	Buried in Ground	Loss of Material External surface corrosion due to the potential for the existence of sufficient oxygen, moisture levels, and/or soil contaminants.	Buried Surfaces External Corrosion Program (B.3.2)
3.3.2.87	Pump Casing	Cast Iron	Fuel Oil	Loss of Material • MIC due to the potential for microorganism introduction and moisture contamination during bulk fuel oil supply and delivery • Pitting, general and crevice corrosion due to potential for water contamination	Diesel Fuel Monitoring and Storage Program (B.2.7)

[45] **RAI # 3.3.2-7**

Table 3.3-2
Fort Calhoun Auxiliary Systems Component Types Subject to Aging Management Not Evaluated in NUREG-1801

Row Number	Component Types	Material	Environment	AERMs	Program/Activity
3.3.2.88	Pump Casing	Cast Iron	Lubricating Oil	Loss of Material Pitting, general and crevice corrosion due to potential for water contamination	Periodic Surveillance and Preventive Maintenance Program (B.2.7)
3.3.2.89	Heat exchangers - shell and tube sheet, *pipes & fittings,* tanks, valves	Carbon Steel, Cadmium Plated Steel	Lubricating Oil	Loss of Material General corrosion due to the possibility for water contamination and water pooling.	Periodic Surveillance and Preventive Maintenance Program (B.2.7)
3.3.2.90	Blower and fan housing	Cast Iron	Containment Air	Loss of Material due to general corrosion where both oxygen and moisture are present	Periodic Surveillance and Preventive Maintenance Program (B.2.7)
3.3.2.91	Piping and fittings, *heat exchangers*	Copper, *copper alloy*	Ambient Air	Loss of Material due to wear	Periodic Surveillance and Preventive Maintenance Program (B.2.7)
3.3.2.92	Bolting	Zinc Plated Steel	Buried in Ground	Loss of Material External surface corrosion due to the potential for the existence of sufficient oxygen, moisture levels, and/or soil contaminants	Fire Protection Program (B.2.5)
3.3.2.93	Filter/strainers, valves, **pump casings**[46]	Cast Iron, **ductile iron**[42]	Ambient Air	Loss of Material due to general corrosion where both oxygen and moisture are present	Fire Protection Program (B.2.5)

[46] **RAI # 2.3.3.14-2**

Table 3.3-2
Fort Calhoun Auxiliary Systems Component Types Subject to Aging Management Not Evaluated in NUREG-1801

Row Number	Component Types	Material	Environment	AERMs	Program/Activity
3.3.2.94	Piping and fittings	Galvanized Steel	Raw Water	Loss of Material due to general, crevice, pitting and galvanic corrosion and MIC.	Fire Protection Program (B.2.5)
3.3.2.95	~~Traveling Screen Frame~~ **Valve bodies**[42]	~~Carbon Steel~~ **Stainless Steel**[42]	~~Raw Water~~ **Deoxygenated Treated Water <200F**[42]	~~Loss of Material due to general, crevice, pitting, and galvanic corrosion and MIC~~ **Cracking and Loss of Material due to pitting and crevice corrosion.**[42]	~~Periodic Surveillance and Preventive Maintenance Program (B.2.7)~~ **Fire Protection Program (B.2.5)**[42]
3.3.2.96	Piping and fittings, *valves*	Stainless Steel	Borated Treated Water	Cracking Stress corrosion cracking	Periodic Surveillance and Preventive Maintenance Program (B.2.7)

Red & Italics – Review based changes
Blue & Bold – RAI based changes

TABLE 3.3-3
Components in Auxiliary Systems not Evaluated in NUREG-1801 that Rely on Aging Management Programs in NUREG-1801 for FCS License Renewal

Row Number	FCS Components	FCS Material	FCS Environment	FCS AERMs	FCS Program Activity	Applicable NUREG-1801 AMR Results Row Number	Justification for Applying NUREG-1801 Aging Management Review Results
3.3.3.01	Pipes, fittings, valve bodies, filter casings, pump casings, ion exchangers and heat exchangers, *flow element/ orifice, transmitter/ element*	Stainless steel	Borated Treated Water	Cracking Stress corrosion cracking	Chemistry Program (B.1.2)	3.2.1.10[47]	The FCS components are made of the same material, exposed to the same environment, subject to the same aging effects and managed by the same aging management program as the components evaluated in NUREG-1801 Volume 2, **V.A.1-a, V.A.3-a, V.A.4-a, and**[43] V.D1.1-a
3 3.3.02	Fuel transfer carrier box, fuel transfer conveyor, UGS lift rig, reactor head lift rig, fuel handling tools, fuel transfer tilting machine	Stainless Steel	Ambient Air and Borated Treated Water	Cracking Stress corrosion cracking	Chemistry Program (B.1.2)	3.3.1.11	The FCS components are made of the same material, exposed to the same environment, subject to the same aging effects and managed by the same aging management program as the components evaluated in NUREG-1801 Volume 2 VII.A2 1-c.

[47] **RAI # 3.3-1**

TABLE 3.3-3
Components in Auxiliary Systems not Evaluated in NUREG-1801 that Rely on Aging Management Programs in NUREG-1801 for FCS License Renewal

Row Number	FCS Components	FCS Material	FCS Environment	FCS AERMs	FCS Program Activity	Applicable NUREG-1801 AMR Results Row Number	Justification for Applying NUREG-1801 Aging Management Review Results
3.3.3.03	Pipes, fittings, *valve bodies*	Stainless Steel	Deoxygenated Treated Water (<200F)	Loss of Material	Chemistry Program (B.1.2), **One Time Inspection (B.3.5)**[48]	3.4-1.02	The FCS components are made of the same material, exposed to the same environment, subject to the same aging effects and managed by the same aging management program as the components evaluated in NUREG-1801 Volume 2 VIII.G.4-b.
3.3.3.04	**Not used in application.**[49]						
3.3.3.05	Filter/strainer bodies, flow element/orifice, pipes & fittings, braided flexible hose, *heat exchangers*	Carbon Steel	Lubricating Oil	Loss of Material	Periodic Surveillance and Preventive Maintenance Program (B.2.7)	3.4-1.04	The FCS components are made of the same material, exposed to the same environment, subject to the same aging effects and managed by the same aging management program as the components evaluated in NUREG-1801 Volume 2 VIII.G.5-d.

[48] **RAI # 3.3.3-2**
[49] **RAI # 3.3.3-3**

TABLE 3.3-3
Components in Auxiliary Systems not Evaluated in NUREG-1801 that Rely on Aging Management Programs in NUREG-1801 for FCS License Renewal

Row Number	FCS Components	FCS Material	FCS Environment	FCS AERMs	FCS Program Activity	Applicable NUREG-1801 AMR Results Row Number	Justification for Applying NUREG-1801 Aging Management Review Results
3.3.3.06	Filter/strainer bodies, pipes & fittings, valves, pumps~~, tanks~~	Carbon Steel	Fuel Oil	Loss of Material	Diesel Fuel Monitoring and Storage Program (B 2.3)	3.3-1.07	The FCS components are made of the same material, exposed to the same environment, subject to the same aging effects and managed by the same aging management program as the components evaluated in NUREG-1801 Volume 2 VII.H1.4-a.

TABLE 3.3-3
Components in Auxiliary Systems not Evaluated in NUREG-1801 that Rely on Aging Management Programs in NUREG-1801 for FCS License Renewal

Row Number	FCS Components	FCS Material	FCS Environment	FCS AERMs	FCS Program Activity	Applicable NUREG-1801 AMR Results Row Number	Justification for Applying NUREG-1801 Aging Management Review Results
3.3.3.07	Valve bodies, piping & fittings, fan housings, bolts, duct, pumps, *filters/strainers*	Cast Iron, cadmium plated steel, galvanized steel, *ductile iron*	Ambient Air	Loss of Material	General Corrosion of Ext. Surfaces Program (B.3.3)	3.3-1.05	The material is subject to the same environment and aging effect, and managed by the same aging management program as evaluated in Item 3.3.1.05. The aging effect is independent of component type.
3.3.3.08	Electric heaters ~~sleeves~~[50], tanks, heat exchanger, orifice, *indicator/ recorder*	Carbon Steel, *stainless steel*	Corrosion-Inhibited Treated Water	Loss of Material	Chemistry Program (B.1.2) and Cooling Water Corrosion Program (B.2.2)	3.3-1.14	The FCS components are made of the same material, exposed to the same environment, subject to the same aging effects and managed by the same aging management program as the components evaluated in NUREG-1801 Volume 2 VII.H2.1-a and VII.C2.5-a

[50] RAI # 3.3.3-4

TABLE 3.3-3
Components in Auxiliary Systems not Evaluated in NUREG-1801 that Rely on Aging Management Programs in NUREG-1801 for FCS License Renewal

Row Number	FCS Components	FCS Material	FCS Environment	FCS AERMs	FCS Program Activity	Applicable NUREG-1801 AMR Results Row Number	Justification for Applying NUREG-1801 Aging Management Review Results
3.3.3.09	Valve bodies, piping & fittings, duct, damper, bolts, heat exchangers, *filters/strainers, fan housings, pumps, transmitter/ element*	Cast Iron, cadmium plated steel, galvanized steel, copper alloy, *ductile iron*	Ambient Air	Loss of Material **due to boric acid corrosion**[51]	Boric Acid Corrosion (BAC) Prevention Program (B.2.1)	3.3-1.13	The material is subject to the same environment and aging effect, and managed by the same aging management program as evaluated in Item 3.3.1.13. The aging effect is independent of component type.
3.3.3.10	~~*Fire blocking*~~ *dDampers*, duct, valve bodies, fan housings, *heat exchangers*	Galvanized steel, cast iron	Ambient Air	Loss of Material	Periodic Surveillance and Preventive Maintenance Program (B.2.7)	3.3-1.05	The FCS components are ~~*made of the same material,*~~ exposed to the same environment, subject to the same aging effects and managed by the same aging management program as the components evaluated in NUREG-1801 Volume 2 VII.F2.1-a

[51] RAI # 3.3.3-1

TABLE 3.3-3
Components in Auxiliary Systems not Evaluated in NUREG-1801 that Rely on Aging Management Programs in NUREG-1801 for FCS License Renewal

Row Number	FCS Components	FCS Material	FCS Environment	FCS AERMs	FCS Program Activity	Applicable NUREG-1801 AMR Results Row Number	Justification for Applying NUREG-1801 Aging Management Review Results
3.3.3.11	Filter/strainer, valve, heat exchanger, **flow element/orifice, FP sprinkler/ spray nozzle, pipes & fittings, pump casings, switch/bistable housing**[52]	Cast iron, **brass, bronze, copper alloy**	Raw Water	Loss of Material	Cooling Water Corrosion Program (B.2.2), Periodic Surveillance and Preventive Maintenance Program (B.2.7), **or Fire Protection Program (B.2.5)** and Selective Leaching Program (B.3.6) ~~**for externally exposed components**~~	3.3-1.16 3.3-1.24	The FCS components are made of the same material, exposed to the same environment, subject to the same aging effects and managed by the same aging management program as the components evaluated in NUREG-1801 Volume 2 VII.C1.5-a
3.3.3.12	Heat exchanger, Pumps, Indicator /Recorder	Stainless Steel	Raw Water	Loss of Material Biofouling	Cooling Water Corrosion Program (B.2.2)	3.3-1.16	The FCS components are made of the same material, exposed to the same environment, subject to the same aging effects and managed by the same aging management program as the components evaluated in NUREG-1801 Volume 2 VII.C1.4-a

[52] **RAI # 2.3.3.14-2**

TABLE 3.3-3
Components in Auxiliary Systems not Evaluated in NUREG-1801 that Rely on Aging Management Programs in NUREG-1801 for FCS License Renewal

Row Number	FCS Components	FCS Material	FCS Environment	FCS AERMs	FCS Program Activity	Applicable NUREG-1801 AMR Results Row Number	Justification for Applying NUREG-1801 Aging Management Review Results
3.3.3.13	Heat exchanger	Stainless Steel	Corrosion-Inhibited Treated Water	Cracking	Cooling Water Corrosion Program (B.2.2), *Chemistry Program*	3.3-1.08	The FCS components are made of the same material, exposed to the same environment, subject to the same aging effects and managed by the same aging management program as the components evaluated in NUREG-1801 Volume 2 VII.E1.8-b
3.3.3.14	Traveling Screen Frame	Carbon Steel	Raw Water	Loss of Material	Cooling Water Corrosion Program (B.2.2)	3.3-1.16	The FCS components are made of the same material, exposed to the same environment, subject to the same aging effects and managed by the same aging management program as the components evaluated in NUREG-1801 Volume 2 VII.C1.1-a

TABLE 3.3-3
Components in Auxiliary Systems not Evaluated in NUREG-1801 that Rely on Aging Management Programs in NUREG-1801 for FCS License Renewal

Row Number	FCS Components	FCS Material	FCS Environment	FCS AERMs	FCS Program Activity	Applicable NUREG-1801 AMR Results Row Number	Justification for Applying NUREG-1801 Aging Management Review Results
3.3.3.15	Pipes & fittings, Indicator /Recorder, Heat Exchanger	Stainless Steel	Corrosion-Inhibited Treated Water	Loss of Material	Chemistry Program (B.1.2) and Cooling Water Corrosion Program (B.2.2)	3.3-1.14	The FCS components are made of the same material, exposed to the same environment, subject to the same aging effects and managed by the same aging management program as the components evaluated in NUREG-1801 Volume 2 VII.C2.2-a

Red & Italics – Review based changes
Blue & Bold – RAI based changes

Table 3.4-1.
Summary of Aging Management Programs for the Steam and Power Conversion System Evaluated in NUREG-1801 that are Relied on for FCS License Renewal

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.4.1.01	Piping and fittings in main feedwater line, steam line and AFW piping (PWR only)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA	1. The TLAA is applicable to Class II and III piping at FCS. See Section 4.3.4 for the TLAA discussion of Class II and III Piping. 2. Consistent with NUREG-1801, this group includes piping, fittings, and valve bodies at FCS.
3.4.1.02	Piping and fittings, valve bodies and bonnets, pump casings, tanks, tubes, tubesheets, channel head and shell (except main steam system)	Loss of material due to general (carbon steel only), pitting, and crevice corrosion	Water chemistry and one-time inspection	Yes, detection of aging effects is to be further evaluated	1. The Chemistry Program (B.1.2), supplemented by the One-Time Inspection Program (B.3.5) manages the aging effects of these components. The programs are described in Appendix B of this application. NUREG-1801 indicates that the verification of the effectiveness of the water chemistry program should be conducted with an inspection of stagnant flow locations within the systems. These inspections will be conducted in accordance with the One-Time Inspection Program. 2. Consistent with NUREG-1801, this group includes carbon steel **and stainless steel**[53] in treated water at FCS.
3.4.1.03	Auxiliary feedwater (AFW) piping	Loss of material due to general, pitting, and crevice corrosion, MIC, and biofouling	Plant specific	Yes, plant specific	The environment identified in NUREG-1801 is not applicable to FCS. The AFW piping at FCS is not exposed to untreated water from backup water supply

[53] **RAI # 3.3.3-6**

Table 3.4-1.
Summary of Aging Management Programs for the Steam and Power Conversion System Evaluated in NUREG-1801 that are Relied on for FCS License Renewal

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.4.1.04	Oil coolers in AFW system (lubricating oil side possibly contaminated with water)	Loss of material due to general (carbon steel only), pitting, and crevice corrosion and MIC	Plant specific	Yes, plant specific	1. The Periodic Surveillance and Preventive Maintenance Program (B.2.7) manages this aging effect by ensuring water is not present in lubricating oil and that the oil is changed on a refueling frequency. This program is described in Appendix B of this application. 2. Consistent with NUREG-1801, this group includes carbon steel and stainless steel in lubricating oil possibly contaminated with water at FCS
3.4.1.05	External surface of carbon steel components	Loss of material due to general corrosion	Plant specific	Yes, plant specific	1. The General Corrosion of External Surfaces Program (B.3.3) manages this aging effect. This program is described in Appendix B of this application. 2. Consistent with NUREG-1801, this group includes carbon and low alloy steel in ambient air at FCS.
3.4.1.06	Carbon steel piping and valve bodies	Wall thinning due to flow-accelerated corrosion	Flow-accelerated corrosion	No	1. The aging management results are consistent with the results reviewed and approved in NUREG-1801. 2. Consistent with NUREG-1801, this group includes carbon steel in treated water and saturated steam at FCS.
3.4.1.07	Carbon steel piping and valve bodies in main steam system	Loss of material due to pitting and crevice corrosion	Water chemistry	No	1. The aging management results are consistent with the results documented in NUREG-1801. 2. Consistent with NUREG-1801, this group includes carbon steel in saturated steam at FCS.

Table 3.4-1.
Summary of Aging Management Programs for the Steam and Power Conversion System Evaluated in NUREG-1801 that are Relied on for FCS License Renewal

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.4.1.08	Closure bolting in high-pressure or high-temperature systems	Loss of material due to general corrosion; crack initiation and growth due to cyclic loading and/or SCC.	Bolting integrity	No	1. The aging management results are consistent with the results documented in NUREG-1801. 2. Consistent with NUREG-1801, this group includes carbon and low alloy steel bolting in ambient air in high pressure or high temperature systems at FCS
3.4.1.09	Heat exchangers and coolers/ condensers serviced by open-cycle cooling water	Loss of material due to general (carbon steel only), pitting, and crevice corrosion, MIC, and biofouling; buildup of deposit due to biofouling	Open-cycle cooling water system	No	The combinations of materials and environment identified in NUREG-1801 are not applicable to FCS. The applicable heat exchangers are not serviced by open-cycle cooling water

Table 3.4-1.
Summary of Aging Management Programs for the Steam and Power Conversion System Evaluated in NUREG-1801 that are Relied on for FCS License Renewal

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.4.1.10	Heat exchangers and coolers/ condensers serviced by closed-cycle cooling water	Loss of material due to general (carbon steel only), pitting, and crevice corrosion	Closed-cycle cooling water system	No	1. The aging management results are consistent with the results documented in NUREG-1801. 2. Consistent with NUREG-1801, this group includes stainless steel components in corrosion inhibited treated water at FCS. *3. At FCS, the "Closed Cycle Cooling Water System Program" is comprised of the Chemistry Program (B.1.2) and the Cooling Water Corrosion Program (B.2.2).* *4. For FCS, MIC and galvanic corrosion are also AERMs for this material and environment.*
3.4.1.11	External surface of aboveground condensate storage tank	Loss of material due to general (carbon steel only), pitting, and crevice corrosion	Aboveground carbon steel tanks	No	The component identified in NUREG-1801 is not applicable to FCS.
3.4.1.12	External surface of buried condensate storage tank and AFW piping	Loss of material due to general, pitting, and crevice corrosion and MIC	Buried piping and tanks surveillance or Buried piping and tanks inspection	No Yes, detection of aging effects and operating experience are to be further evaluated (see subsection 3 4.2.2.5 2)	The components identified in NUREG-1801 are not applicable to FCS.

Table 3.4-1.
Summary of Aging Management Programs for the Steam and Power Conversion System Evaluated in NUREG-1801 that are Relied on for FCS License Renewal

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.4.1.13	External surface of carbon steel components	Loss of material due to boric acid corrosion	Boric acid corrosion	No	1. The aging management results are consistent with the results documented in NUREG-1801. 2. Consistent with NUREG-1801, this group includes carbon and low alloy steel components in ambient air and leaking and dripping chemically treated borated water at FCS.

Red & Italics – Review based changes
Blue & Bold – RAI based changes

TABLE 3.4-2
FCS Steam and Power Conversion System Component Types Subject to Aging Management Review not Evaluated in NUREG-1801

Row Number	Component Types	Material	Environment	AERMs	Program/Activity
3.4.2.01	Pumps	Aluminum	Lubricating Oil	Loss of Material General corrosion due to the possibility for water contamination and water pooling.	Periodic Surveillance and Preventive Maintenance Program (B.2.7)
3.4.2.02	Pumps	Aluminum	Plant Indoor Air	None	Not Applicable
3.4.2.03	Heat exchanger (channel, channel head, tubes) and valves	Copper Alloy	Deoxygenated Treated Water	Loss of Material • Crevice and pitting corrosion due to potential stagnant or low flow conditions. • Wear due to flow induced vibration	One Time Inspection Program (B.3.5) *Water Chemistry Program (B.1.2)*
3.4.2.04	Heat exchanger (channel, channel head, tubes) and valves	Copper Alloy	Deoxygenated Treated Water	Loss of Material • Selective leaching	Selective Leaching Program (B.3.6) *One Time Inspection Program (B.3.5)*
3.4.2.05	Filters/strainers, heat exchanger (shell and tubes), indicator/ recorder body, pipes, fittings and valves	Copper Alloy	Lubricating Oil	Loss of Material General corrosion due to the possibility for water contamination and water pooling.	Periodic Surveillance and Preventive Maintenance Program (B.2 7)
3.4.2.06	External surface of copper alloy components	Copper Alloy	Ambient Air	None	Not Applicable
3.4.2.07	Indicator/recorder	Glass	Deoxygenated Treated Water Lubricating Oil Ambient Air	None	Not Applicable

TABLE 3.4-2
FCS Steam and Power Conversion System Component Types Subject to Aging Management Review not Evaluated in NUREG-1801

Row Number	Component Types	Material	Environment	AERMs	Program/Activity
3.4 2.08	External surface of stainless steel components	Stainless Steel	Ambient Air	None	Not Applicable
3.4.2.09	Pipes, fittings, valves, filter/strainer, flow element/orifice, transmitter element, pump casing	Stainless Steel	Oxygenated or Deoxygenated Treated Water	Cracking Due to exposure of stainless steel to halogens and sulfates.	Water Chemistry (B.1.2) and One-Time Inspection (B.3.5)
3.4.2.10	Pipes, fittings, and valves	Stainless Steel	Deoxygenated Treated Water or Saturated Steam	Cracking Due to exposure of stainless steel to halogens and sulfates.	Water Chemistry (B.1.2) and One-Time Inspection (B.3.5)
3.4.2.11	Pipes, fittings, and valves	Stainless Steel	Deoxygenated Treated Water or Saturated Steam	Loss of Material • Crevice corrosion due exposure of stainless steel to dissolved oxygen • Pitting corrosion due to the exposure of stainless steel to halogens and sulfates	Water Chemistry (B.1.2) and One-Time Inspection (B.3.5)

Red & Italics – Review based changes
Blue & Bold – RAI based changes (NONE)

TABLE 3.4-3
Components not Evaluated in NUREG-1801 that Rely on Aging Management Programs for Steam and Power Conversion Systems in NUREG-1801 for FCS License Renewal

Row Number	FCS Components	FCS Material	FCS Environment	FCS AERMs	FCS Program Activity	Applicable NUREG-1801 AMR Results Row Number	Justification for applying NUREG-1801 Aging Management Review Results
3.4.3.01	Filter/strainer, pumps	Carbon Steel, *Stainless Steel*	Lubricating Oil	Loss of Material	Periodic Surveillance and Preventive Maintenance Program (B.2.~~8~~7)	3.4.1.04	The FCS components are made of the same material, exposed to the same environment, subject to the same aging effects and managed by the same aging management program as the components evaluated in NUREG-1801 Volume 2 VIII.G.5-d
3.4.3.02	Filter/strainer, flow element/orifice housing, pipes & fittings	Stainless Steel	Deoxygenated Treated Water	Loss of Material	Chemistry Program (B.1.2), supplemented by the One-Time Inspection Program (B.3.5)	3.4.1.02	The FCS components are made of the same material, exposed to the same environment, subject to the same aging effects and managed by the same aging management program as the components evaluated in NUREG-1801 Volume 2 VIII.G.4-b

TABLE 3.4-3
Components not Evaluated in NUREG-1801 that Rely on Aging Management Programs for Steam and Power Conversion Systems in NUREG-1801 for FCS License Renewal

Row Number	FCS Components	FCS Material	FCS Environment	FCS AERMs	FCS Program Activity	Applicable NUREG-1801 AMR Results Row Number	Justification for applying NUREG-1801 Aging Management Review Results
3.4.3.03	Turbine casing, filter/strainer, pipes & fittings, valve bodies	Carbon Steel, *Low Alloy Steel*	Saturated Steam	Loss of Material	Chemistry Program (B.1.2)	3.4.1.07	The FCS components are made of the same material, exposed to the same environment, subject to the same aging effects and managed by the same aging management program as the components evaluated in NUREG-1801 Volume 2 VIII.B1.2-a and VIII.B1.1-a
3.4.3.04	Filter/strainer, pipes & fittings, valve bodies	Carbon Steel, *Low Alloy Steel*	Saturated Steam	Loss of Material	Flow Accelerated Corrosion (FAC) Program (B.1.5)	3.4.1.06	The FCS components are made of the same material, exposed to the same environment, subject to the same aging effects and managed by the same aging management program as the components evaluated in NUREG-1801 Volume 2 VIII.B1.1-c

TABLE 3.4-3
Components not Evaluated in NUREG-1801 that Rely on Aging Management Programs for Steam and Power Conversion Systems in NUREG-1801 for FCS License Renewal

Row Number	FCS Components	FCS Material	FCS Environment	FCS AERMs	FCS Program Activity	Applicable NUREG-1801 AMR Results Row Number	Justification for applying NUREG-1801 Aging Management Review Results
3.4.3.05	Valves	Low Alloy Steel	Deoxygenated Treated Water	Loss of Material	Chemistry Program (B.1.2) supplemented by the One Time Inspection Program (B.3.5)	3.4.1.02	The material is subject to the same environment and aging effect, and managed by the same aging management program as evaluated in Table 3.4-1, Item 3.4.1.02. The aging effect is independent of component type.

Red & Italics – Review based changes
Blue & Bold – RAI based changes (NONE)

Table 3.5-1
Summary of Aging Management Programs for Structures and Component Supports Evaluated in NUREG-1801 that are Relied on for FCS License Renewal

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
Common Components of All Types of PWR Containment					
3.5.1.01	Penetration sleeves, penetration bellows, and dissimilar metal welds	Cumulative fatigue damage (CLB fatigue analysis exists)	TLAA evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA	1. The metal fatigue time limited aging analyses are discussed in Section 4.6 of this application. 2. Consistent with NUREG-1801, this group includes penetration sleeves, penetration bellows, and dissimilar metal welds at FCS.
3.5.1.02	Penetration sleeves, bellows, and dissimilar metal welds.	Cracking due to cyclic loading, or crack initiation and growth due to SCC	Containment ISI and Containment leak rate test	Yes, detection of aging effects is to be evaluated	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801 with the exception of item 4 below. 2. The Containment Inservice Inspection Program (B 1.3) and the Containment Leak Rate Program (B.1.4) manage these aging effects. These programs are described in Appendix B of this application. 3. Consistent with NUREG-1801, this group includes stainless steel in ambient air at FCS. 4. Stress corrosion cracking for stainless steel bellows with dissimilar metal welds is applicable only if the susceptible material is exposed to a corrosive environment The bellows at FCS are not exposed to a corrosive environment; therefore, Stress Corrosion Cracking is not an aging effect requiring management.

Table 3.5-1
Summary of Aging Management Programs for Structures and Component Supports Evaluated in NUREG-1801 that are Relied on for FCS License Renewal

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1.03	Penetration sleeves, penetration bellows, and dissimilar metal welds	Loss of material due to corrosion	Containment ISI and Containment leak rate test	No	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801. 2. Consistent with NUREG-1801, this group includes carbon steel in ambient air at FCS.
3.5.1.04	Personnel airlock and equipment hatch	Loss of material due to corrosion	Containment ISI and Containment leak rate test	No	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801. 2. Consistent with NUREG-1801, this group includes carbon steel in ambient air at FCS.
3.5.1.05	Personnel airlock and equipment hatch	Loss of leak tightness in closed position due to mechanical wear of locks, hinges and closure mechanism	Containment leak rate test and Plant Technical Specifications	No	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801. 2. Consistent with NUREG-1801, this group includes carbon steel in ambient air at FCS.
3.5.1.06	Seals, gaskets, and moisture barriers	Loss of sealant and leakage through containment due to deterioration of joint seals, gaskets, and moisture barriers	Containment ISI and Containment leak rate test	No	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801. 2. The equipment hatch gasket, made of neoprene, is the only component included in this component group at FCS.

Table 3.5-1
Summary of Aging Management Programs for Structures and Component Supports Evaluated in NUREG-1801 that are Relied on for FCS License Renewal

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
PWR Concrete (Reinforced and Prestressed) and Steel Containment					
3 5.1.07	Concrete elements: foundation, walls, dome.	Aging of accessible and inaccessible concrete areas due to leaching of calcium hydroxide, aggressive chemical attack, and corrosion of embedded steel	Containment ISI	Yes, if aging mechanism is significant for inaccessible areas	1. The FCS aging management review results are consistent with those reviewed and approved in NUREG-1801. 2. The Containment Inservice Inspection Program (B.1.3) manages the aging effects for these components. This program is described in Appendix B of this application. 3. Leaching of calcium hydroxide from reinforced concrete becomes significant only if the concrete is exposed to flowing water. The reinforced concrete at FCS is not exposed to flowing water. Cracking is controlled through proper arrangement and distribution of reinforcing bars. The concrete at FCS was designed in accordance with ACI 318-63 (per USAR Section 5.3.1 and USAR Section 5.11.3.1) and has these characteristics. Therefore, a plant specific program for below-grade inaccessible areas is not required. 4. Below-grade exterior reinforced concrete at FCS is not exposed to an aggressive environment (pH less than 5.5), or to chloride or sulfate solutions beyond defined limits (greater than 500 ppm chloride, or greater than 1500 ppm sulfate). Periodic monitoring of below-grade water chemistry will be conducted during the period of extended operation to demonstrate that the below-grade environment is not aggressive. Therefore, a plant specific aging management program for below-grade inaccessible areas is not required.

Table 3.5-1
Summary of Aging Management Programs for Structures and Component Supports Evaluated in NUREG-1801 that are Relied on for FCS License Renewal

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1.08	Concrete elements: foundation	Cracks, distortion, and increases in component stress level due to settlement	Structures Monitoring	No, if within the scope of the applicant's structures monitoring program	1. The aging management results are consistent with those reviewed and approved in NUREG 1801. Applicable components are within the scope of the Structures Monitoring Program (B.2.10) described in Appendix B of this application. 2. The structures at FCS are supported on end-bearing steel pipe piles driven to bedrock. Settlement of the concrete subfoundation is not a plausible aging mechanism. A de-watering system is not relied upon for control of settlement at FCS.
3.5.1.09	Concrete elements: foundation	Reduction in foundation strength due to erosion of porous concrete subfoundation	Structures Monitoring	No, if within the scope of the applicant's structures monitoring program	1. The aging management results are consistent with those reviewed and approved in NUREG-1801. Applicable components are within the scope of the Structures Monitoring Program (B.2.10) described in Appendix B of this application. 2. The reinforced concrete at FCS is not exposed to flowing water and a de-watering system is not relied upon for control of erosion of cement from porous concrete subfoundations.
3.5 1.10	Concrete elements: foundation, dome, and wall	Reduction of strength and modulus due to elevated temperature	Plant specific	Yes, for any portions of concrete containment that exceed specified temperature limits	Subsection CC-3400 of ASME Section III, Division 2, specifies the concrete temperature limits for normal operation or any other long-term period. The temperatures shall not exceed 150 deg F except for local areas that are allowed to have increased temperatures not to exceed 200 deg F. Per USAR Section 2.5.2.3, the record high temperature in the vicinity of FCS was 114 deg F in July 1936. This is below the temperature limit of 150 deg F. USAR Table 9.10-1 provides maximum

Table 3.5-1
Summary of Aging Management Programs for Structures and Component Supports Evaluated in NUREG-1801 that are Relied on for FCS License Renewal

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
					building/room temperatures for the Auxiliary Building, Turbine Building, Containment, Control Room, Engine Driven Auxiliary Feedwater Pump Room, Radioactive Waste Processing Building, Chemistry and Radiation Protection Building, and Office/Cafeteria Addition. The maximum indoor plant temperature in Table 9.10-1 is 120 deg F inside the main area of containment. This is below the temperature limit of 150 deg F. Per USAR Section 5.5.4, sleeve radiation fins and thermal sleeves (in conjunction with pipe insulation) are used to limit maximum temperature at the containment penetration sleeves to 150 deg F under operating conditions. The nuclear detector well cooling system cools the out of-core neutron detectors, which are located in tubes or wells in the reactor compartment annulus between the lower portion of the reactor vessel and the biological shield, and maintains the shield concrete temperature below 150 deg F. Technical Specification Limiting Condition for Operation 2.13 requires that the annulus exit temperature from the nuclear detector cooling system shall not exceed a temperature found to correlate to 150 deg F concrete temperature. Therefore, no portions of concrete containment exceed specified temperature limits and no aging management is required.

Table 3.5-1
Summary of Aging Management Programs for Structures and Component Supports Evaluated in NUREG-1801 that are Relied on for FCS License Renewal

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1.11	Prestressed containment: tendons and anchorage components	Loss of prestress due to relaxation, shrinkage, creep, and elevated temperature	TLAA evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA	1. See Section 4.5 for the TLAA discussion of containment tendons. 2. Consistent with NUREG-1801 this group includes containment tendons and anchorage components at FCS.
3.5.1.12	Steel elements: liner plate, containment shell	Loss of material due to corrosion in accessible and inaccessible areas	Containment ISI and Containment leak rate test	Yes, if corrosion is significant for inaccessible areas	1. The aging management results are consistent with those reviewed and approved in NUREG-1801. 2. Corrosion for inaccessible areas (embedded containment liner) is not significant because: a. Concrete meeting the requirements of ACI 318 or 349 and the guidance of 201.2R was used for the containment concrete in contact with the embedded containment liner. b. The concrete is monitored to ensure that it is free of penetrating cracks that provide a path for water seepage to the surface of the containment shell or liner. c. The moisture barrier, at the junction where the shell or liner becomes embedded, is subject to aging management activities in accordance with IWE requirements. d. Borated water spills and water ponding on the containment concrete floor are not common and when detected are cleaned up in a timely manner.

Table 3.5-1
Summary of Aging Management Programs for Structures and Component Supports Evaluated in NUREG-1801 that are Relied on for FCS License Renewal

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1.13	Steel elements: protected by coating	Loss of material due to corrosion in accessible areas only	Protective coating monitoring and maintenance	No	The combinations of components, materials and environments identified in NUREG-1801 are not applicable to FCS. Protective coatings are not relied on to manage the effects of aging at FCS. The Aging Management Review evaluated in NUREG-1801 is not relied on for the FCS license renewal.
3.5.1.14	Prestressed containment: tendons and anchorage components	Loss of material due to corrosion of prestressing tendons and anchorage components	Containment ISI	No	1. The aging management results are consistent with those reviewed and approved in NUREG-1801. 2. Consistent with NUREG-1801, this group includes containment tendons and anchorage components at FCS.
3.5.1.15	Concrete elements: foundation, dome, and wall	Scaling, cracking, and spalling due to freeze-thaw; expansion and cracking due to reaction with aggregate	Containment ISI	No	1. The aging management results are consistent with those reviewed and approved in NUREG-1801. 2. Consistent with NUREG-1801, this group includes concrete exposed to ambient air and below grade concrete at FCS.
Class I Structures					
3.5.1.16	All Groups except Group 6: accessible interior/exterior concrete & steel components	All types of aging effects	Structures Monitoring	No, if within the scope of the applicant's structures monitoring program	1. The aging management results are consistent with those reviewed and approved in NUREG 1801. Applicable components are within the scope of the Structures Monitoring Program (B.2.10) described in Appendix B of this Application 2. As described in NUREG-1557, freeze/thaw does not cause loss of material from reinforced concrete in foundations, and in above and below

Table 3.5-1
Summary of Aging Management Programs for Structures and Component Supports Evaluated in NUREG-1801 that are Relied on for FCS License Renewal

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
					grade exterior concrete, for plants located in a geographic region of negligible weathering conditions (weathering index <100 day-inch/yr). Loss of material from such concrete is not significant at plants located in areas in which weathering conditions are severe (weathering index >500 day-inch/yr) or moderate (100-500 day-inch/yr), provided that the concrete mix design meets the air content (entrained air 3-6%) and water-to-cement ratio (0.35-0.45) specified in ACI 318-63 or ACI 349-85. The weathering index for FCS is >500 day-inch/yr. The concrete mix design specified a water-to-cement ratio of 0.38 and air entrainment of 4.75% + 0.75% for Class A concrete for FCS. It specified a water-to-cement ratio of 0.44 and air entrainment of 5.00% + 1.00% for Class B concrete. Therefore, the conditions of NUREG-1801, Volume 2, Chapter III are satisfied 3. Leaching of calcium hydroxide from reinforced concrete becomes significant only if the concrete is exposed to flowing water. Leaching is not significant if the concrete is constructed to ensure that it is dense, well-cured, has low permeability, and that cracking is well controlled. Cracking is controlled through proper arrangement and distribution of reinforcing bars. The concrete at FCS was designed in accordance with ACI 318-63 (per USAR Section 5.3.1 and USAR Section 5.11.3.1) and has these characteristics. Therefore, the conditions of NUREG- 1801 Volume 2 Chapter III are satisfied.

Table 3.5-1
Summary of Aging Management Programs for Structures and Component Supports Evaluated in NUREG-1801 that are Relied on for FCS License Renewal

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
					4. Investigations, tests, and petrographic examinations of aggregates performed in accordance with ASTM C295-54 or ASTM C227-50 demonstrated that the aggregates used in the construction of FCS do not react within reinforced concrete. Concrete for FCS was constructed in accordance with ACI 201.2R-77. C. Therefore, the conditions of NUREG-1801, Volume 2, Chapter III are satisfied. 5. Per NUREG-1557, corrosion of embedded steel is not significant for concrete structures above or below grade that are exposed to a non-aggressive environment. A non-aggressive environment, as defined by NUREG-1557, is one with a pH greater than 11.5 or chlorides less than 500 ppm. NUREG- 1557 also concludes that corrosion of embedded steel is not significant for concrete structures exposed to an aggressive environment but have a low water-to-cement ratio, adequate air entrainment, and designed in accordance with ACI 318-63 or ACI 349-85. A low water-to-cement ratio is defined as 0.35 to 0.45 and adequate air entrainment is defined as 3 to 6 percent The concrete at FCS is not exposed to aggressive river water or groundwater. There is no heavy industry in the area whose emissions would cause degradation to concrete or steel. The concrete that surrounds the embedded steel has a pH greater than or equal to 12.5. The concrete mix design specified a water-to-cement ratio of 0.38 and air entrainment of 4.75% + 0.75% for Class A

Table 3.5-1
Summary of Aging Management Programs for Structures and Component Supports Evaluated in NUREG-1801 that are Relied on for FCS License Renewal

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
					concrete. It specified a water-to-cement ratio of 0.44 and air entrainment of 5.00% + 1.00% for Class B concrete. Class C concrete was only used for radiation shields; therefore, would not be exposed to an environment that would promote corrosion of embedded steel. The concrete at FCS was designed in accordance with ACI 318-63 (per USAR Section 5.3 1, Revision 0 and USAR Section 5.11.3.1, Revision 2). Therefore, the conditions of NUREG-1801, Volume 2, Chapter III are satisfied and aging management is not required. Below-grade exterior reinforced concrete at FCS is not exposed to an aggressive environment (pH less than 5.5), or to chloride or sulfate solutions beyond defined limits (greater than 500 ppm chloride, or greater than 1500 ppm sulfate). Periodic monitoring of below-grade water chemistry will be conducted during the period of extended operation to demonstrate that the below-grade environment is not aggressive. Therefore, the conditions of NUREG-1801, Volume 2, Chapter III are satisfied. 6. Aggressive chemical attack on reinforced concrete is not significant if the concrete is exposed to a nonaggressive environment. A non-aggressive environment, as defined by GALL, is one with a pH greater than 5.5, chlorides less than 500 ppm, or sulfates less than 1500 ppm. The concrete at FCS is not exposed to aggressive river water or groundwater. There is no heavy industry in the area whose emissions

Table 3.5-1
Summary of Aging Management Programs for Structures and Component Supports Evaluated in NUREG-1801 that are Relied on for FCS License Renewal

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
					would cause degradation to concrete or steel. Therefore, the conditions of NUREG-1801, Volume 2, Chapter III are satisfied. 7. The structures at FCS are supported on end-bearing steel pipe piles driven to bedrock. Settlement of the concrete subfoundation is not a plausible aging mechanism. A de-watering system is not relied upon for control of settlement at FCS. 8. The reinforced concrete at FCS is not exposed to flowing water and a de-watering system is not relied upon for control of erosion of cement from porous concrete subfoundations. 9. Subsection CC-3400 of ASME Section III, Division 2, specifies the concrete temperature limits for normal operation or any other long-term period. The temperatures shall not exceed 150 deg F except for local areas that are allowed to have increased temperatures not to exceed 200 deg F. Per USAR Section 2.5.2.3, the record high temperature in the vicinity of FCS was 114 deg F in July 1936. This is below the temperature limit of 150 deg F. USAR Table 9.10-1 provides maximum building/room temperatures for the Auxiliary Building, Turbine Building, Containment, Control Room, Engine Driven Auxiliary Feedwater Pump Room, Radioactive Waste Processing Building, Chemistry and Radiation Protection Building, and Office/Cafeteria Addition. The maximum indoor plant temperature in Table 9.10-1 is 120 deg F inside the main area of Containment. This is below the temperature

Table 3.5-1
Summary of Aging Management Programs for Structures and Component Supports Evaluated in NUREG-1801 that are Relied on for FCS License Renewal

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
					limit of 150 deg F. Per USAR Section 5.5.4, sleeve radiation fins and thermal sleeves (in conjunction with pipe insulation) are used to limit maximum temperature at the containment penetration sleeves to 150 deg F under operating conditions. The nuclear detector well cooling system cools the out-of-core neutron detectors, which are located in tubes or wells in the reactor compartment annulus between the lower portion of the reactor vessel and the biological shield, and maintains the shield concrete temperature below 150 deg F. Technical Specification Limiting Condition for Operation 2.13 requires that the annulus exit temperature from the nuclear detector cooling system shall not exceed a temperature found to correlate to 150 deg F concrete temperature. Therefore, no portions of concrete containment exceed specified temperature limits and no aging management is required.
3.5.1.17	Groups 1-3, 5, 7-9: inaccessible concrete components, such as exterior walls below grade and foundation	Aging of inaccessible concrete areas due to aggressive chemical attack, and corrosion of embedded steel	Plant-specific	Yes, if an aggressive below-grade environment exists	Below-grade exterior reinforced concrete at FCS is not exposed to an aggressive environment (pH less than 5.5), or to chloride or sulfate solutions beyond defined limits (greater than 500 ppm chloride, or greater than 1500 ppm sulfate). Periodic monitoring of below grade water chemistry will be conducted during the period of extended operation to demonstrate that the below grade environment is not aggressive. Therefore, the conditions of NUREG-1801, Volume 2, Chapter III are satisfied.

Table 3.5-1
Summary of Aging Management Programs for Structures and Component Supports Evaluated in NUREG-1801 that are Relied on for FCS License Renewal

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1.18	Group 6: all accessible/ inaccessible concrete, steel, and earthen components	All types of aging effects, including loss of material due to abrasion, cavitation, and corrosion	Inspection of Water-Control Structures or FERC/US Army Corps of Engineers dam inspections and maintenance	No	The components identified in NUREG-1801 are not applicable to FCS. The plant specific programs for Intake Structure components exposed to flowing river water are discussed in Items 3.5.2.02, 3.5.3.08, and 3.5.2.33 of Table 3.5-2.
3.5.1.19	Group 5: liners	Crack initiation and growth from SCC and loss of material due to crevice corrosion	Water Chemistry Program and Monitoring of spent fuel pool water level	No	1. The aging management results are consistent with those reviewed and approved in NUREG-1801. 2. Consistent with NUREG-1801, this group includes stainless steel in water at FCS. 3. In addition to monitoring of spent fuel pool level the Periodic Surveillance and Preventive Maintenance Program (B.2.7) performs a leak rate analysis of the refueling canal liner.
3.5.1.20	Groups 1-3, 5, 6: all masonry block walls	Cracking due to restraint, shrinkage, creep, and aggressive environment	Masonry Wall	No	1. The aging management results are consistent with those reviewed and approved in NUREG-1801. The masonry wall program is included in the FCS Structures Monitoring Program (B.2.10). 2. Consistent with NUREG-1801, this group includes concrete block in ambient air at FCS.

Table 3.5-1
Summary of Aging Management Programs for Structures and Component Supports Evaluated in NUREG-1801 that are Relied on for FCS License Renewal

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1.21	Groups 1-3, 5, 7-9: foundation	Cracks, distortion, and increases in component stress level due to settlement	Structures Monitoring	No, if within the scope of the applicant's structures monitoring program	1. The aging management results are consistent with those reviewed and approved in NUREG-1801. Applicable components are within the scope of the Structures Monitoring Program (B.2.10) described in Appendix B of this application 2. The structures at FCS are supported on end-bearing steel pipe piles driven to bedrock. Settlement of the concrete subfoundation is not a plausible aging mechanism. A de-watering system is not relied upon for control of settlement at FCS. 3. Consistent with NUREG-1801, this group includes reinforced concrete at FCS.
3.5.1.22	Groups 1-3, 5-9: foundation	Reduction in foundation strength due to erosion of porous concrete subfoundation	Structures Monitoring	No, if within the scope of the applicant's structures monitoring program	1. The aging management results are consistent with those reviewed and approved in NUREG-1801. Applicable components are within the scope of the Structures Monitoring Program (B.2.10) described in Appendix B of this application 2. The reinforced concrete at FCS is not exposed to flowing water and a de-watering system is not relied upon for control of erosion of cement from porous concrete subfoundations. 3. Consistent with NUREG-1801, this group includes reinforced concrete at FCS.

Table 3.5-1
Summary of Aging Management Programs for Structures and Component Supports Evaluated in NUREG-1801 that are Relied on for FCS License Renewal

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1.223[54]	Groups 1-5: concrete	Reduction of strength and modulus due to elevated temperature	Plant-specific	Yes, for any portions of concrete that exceed specified temperature limits	1. The aging management results are consistent with those reviewed and approved in NUREG-1801. Subsection CC-3400 of ASME Section III, Division 2, specifies the concrete temperature limits for normal operation or any other long-term period. The temperatures shall not exceed 150 deg F except for local areas that are allowed to have increased temperatures not to exceed 200 deg F. Per USAR Section 2.5.2.3, the record high temperature in the vicinity of FCS was 114 deg F in July 1936. This is below the temperature limit of 150 deg F. USAR Table 9.10-1 provides maximum building/room temperatures for the Auxiliary Building, Turbine Building, Containment, Control Room, Engine Driven Auxiliary Feedwater Pump Room, Radioactive Waste Processing Building, Chemistry and Radiation Protection Building, and Office/Cafeteria Addition. The maximum indoor plant temperature in Table 9.10-1 is 120 deg F inside the main area of Containment. This is below the temperature limit of 150 deg F. Per USAR Section 5.5 4, sleeve radiation fins and thermal sleeves (in conjunction with pipe insulation) are used to limit maximum temperature at the containment penetration sleeves to 150 deg F under operating conditions. The nuclear detector well cooling system cools the out of core neutron detectors, which are located in tubes or wells in the reactor compartment annulus between the lower portion of the reactor vessel and the biological

[54] RAI 3.5.1-5

Table 3.5-1
Summary of Aging Management Programs for Structures and Component Supports Evaluated in NUREG-1801 that are Relied on for FCS License Renewal

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
					shield, and maintains the shield concrete temperature below 150 deg F. Technical Specification Limiting Condition for Operation 2.13 requires that the annulus exit temperature from the nuclear detector cooling system shall not exceed a temperature found to correlate to 150 deg F concrete temperature. Therefore, no portions of concrete containment exceed specified temperature limits and no aging management is required.
3.5.1.234[55]	Groups 7, 8: liners	Crack Initiation and growth due to SCC; Loss of material due to crevice corrosion	Plant-specific	Yes	The components identified in NUREG-1801 are not applicable to FCS.
Component Supports					
3.5.1.25	All Groups: support members: anchor bolts, concrete surrounding anchor bolts, welds, grout pad, bolted connections, etc.	Aging of component supports	Structures Monitoring	No, if within the scope of the applicant's structures monitoring program	1. The aging management results are consistent with those reviewed and approved in NUREG-1801. Applicable components are within the scope of the Structures Monitoring Program (B.2.10) described in Appendix B of this application. 2. Consistent with NUREG-1801, this group includes carbon steel, grout and epoxy grout and reinforced concrete exposed to ambient air at FCS.

[55] RAI 3.5.1-5

Table 3.5-1
Summary of Aging Management Programs for Structures and Component Supports Evaluated in NUREG-1801 that are Relied on for FCS License Renewal

Row Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1.26	Groups B1.1, B1.2, and B1.3: support members: anchor bolts, welds	Cumulative fatigue damage (CLB fatigue analysis exists)	TLAA evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA	A CLB fatigue analysis does not exist at FCS Station.
3.5.1.27	All Groups: support members: anchor bolts, welds	Loss of material due to boric acid corrosion	Boric acid corrosion	No	1. The aging management results are consistent with those reviewed and approved in NUREG-1801. 2. Consistent with NUREG-1801, this group includes carbon steel exposed to ambient air at FCS.
3.5.1.28	Groups B1.1, B1.2, and B1.3: support members: anchor bolts, welds, spring hangers, guides, stops, and vibration isolators	Loss of material due to environmental corrosion; loss of mechanical function due to corrosion, distortion, dirt, overload, etc.	ISI	No	1. The aging management results are consistent with those reviewed and approved in NUREG-1801. 2. Consistent with NUREG-1801, this group includes carbon steel exposed to ambient air at FCS.
3.5.1.29	Group B1.1: high strength low-alloy bolts	Crack initiation and growth due to SCC	Bolting integrity	No	1. The aging management results are consistent (with deviation) with the results documented in NUREG-1801. 2. The Bolting Integrity Program (B.1.1) discussed in Appendix B of this application includes an alternative means of managing cracking due to SCC. 3. Consistent with NUREG-1801, this group includes high strength low-alloy bolts exposed to ambient air at FCS.

Red & Italics – Review based changes (NONE)
Blue & Bold – RAI based changes

TABLE 3.5-2
AGING MANAGEMENT PROGRAMS FOR CONTAINMENT, STRUCTURES AND COMPONENT SUPPORTS THAT ARE NOT ADDRESSED IN NUREG-1801

Row Number	Component Types	Material	Environment	AERMs	Program/Activity
3.5.2.01	Removable slab lifting devices	Bronze	Plant Indoor Air	None	Not Applicable
3.5.2.02	Intake Structure sluice gate operator gland, pump gland and gland bolting	Bronze, brass	Raw Water	Loss of Material • Crevice and pitting corrosion and MIC due to stagnant conditions • Galvanic corrosion due to the conductivity of the process fluid and the presence of dissimilar metals in contact.	Structures Monitoring Program (B.2.10)
3.5.2.03	Class A pipe piles are partially filled with soil during placement and then are filled with sand to the point four feet below the top of the pile. The remaining four feet are then filled with concrete.	Carbon Steel	Below Grade	None	Not Applicable
3.5.2.04	Class B pipe piles Diesel engine fuel oil storage tank H-piles	Carbon Steel	Below Grade	None	Not Applicable
3.5.2.05	Class B pipe piles	Carbon Steel	Concrete	None	Not Applicable
3.5.2.06	Class A pipe piles are partially filled with soil during placement and then are filled with sand to the point four feet below the top of the pile. The remaining four feet are then filled with concrete.	Carbon Steel	Concrete/Sand/Soil	None	Not Applicable

TABLE 3.5-2
AGING MANAGEMENT PROGRAMS FOR CONTAINMENT, STRUCTURES AND COMPONENT SUPPORTS THAT ARE NOT ADDRESSED IN NUREG-1801

Row Number	Component Types	Material	Environment	AERMs	Program/Activity
3.5.2.07	Manhole flange, Structural steel	Carbon Steel	Outside Air	Loss of Material General corrosion due to the exposure of external surfaces to varying levels of humidity.	Periodic Surveillance and Preventive Maintenance Program (B 2.7)
3.5.2.08	Intake Structure carbon steel pipe, pipe sleeve, flange and pipe casing floor penetration	Carbon Steel	Raw Water	Loss of Material • Crevice and general corrosion due to oxygenated raw water environment. • Pitting corrosion due to oxygenated raw water environment and stagnant or low flow conditions. • Galvanic corrosion due to the conductivity of the process fluid and dissimilar metals in contact. • MIC due to exposure to microbiological activity	Periodic Surveillance and Preventive Maintenance Program (B.2.7)

TABLE 3.5-2
AGING MANAGEMENT PROGRAMS FOR CONTAINMENT, STRUCTURES AND COMPONENT SUPPORTS THAT ARE NOT ADDRESSED IN NUREG-1801

Row Number	Component Types	Material	Environment	AERMs	Program/Activity
3.5.2.09	Intake Structure cast iron stuffing box floor penetration	Cast Iron	Raw Water	Loss of Material • Crevice and general corrosion due to oxygenated raw water environment. • Pitting corrosion due to oxygenated raw water environment and stagnant or low flow conditions. • Galvanic corrosion due to the conductivity of the process fluid and dissimilar metals in contact. • MIC due to exposure to microbiological activity • Selective leaching due to the exposure of cast iron to dissolved oxygen	Structures Monitoring Program (B.2.10) Selective Leaching Program (B.3.6)
3.5.2.10	Concrete caissons	Concrete	Below Grade	None	Not Applicable

TABLE 3.5-2
AGING MANAGEMENT PROGRAMS FOR CONTAINMENT, STRUCTURES AND COMPONENT SUPPORTS THAT ARE NOT ADDRESSED IN NUREG-1801

Row Number	Component Types	Material	Environment	AERMs	Program/Activity
3.5.2.11	Concrete encased in Class B pipe piles is protected from aggressive environments. The concrete has a compressive strength of 4000 psi, a maximum water-to-cement ratio of 6 gallons/sack or 0.53, and the minimum cement content is 6.50 sacks/cubic yard. The aggregate used has been specified to be non-reactive when mixed with Portland cement and water.	Concrete	Carbon Steel	None	Not Applicable
3.5.2.12	Not used in application				
3.5.2.13	Intake Structure EDPM rubber Link-Seal	EPDM Rubber	Raw Water	Change in Material Properties due to chemical exposure	Structures Monitoring Program (B.2.10)
3.5.2.14	Intake Structure raw water pump rubber foundation seal	EPDM Rubber	Raw Water	Change in Material Properties due to chemical exposure	General Corrosion of External Surfaces Program (B.3.3)
3.5.2.15	Glass in metal fire penetration barriers	Glass	Plant Indoor Air	None	Not Applicable
3.5.2.16	Intake Structure sand and gravel surrounding the diesel fire pump fuel storage tank	Gravel	Ambient Air Protected from Weather	None	Not Applicable
3.5.2.17	Manhole covers and flange	Gray Cast Iron	Ambient Air	Loss of Material • General corrosion and selective leaching due to the exposure of external surfaces to varying levels of humidity	Periodic Surveillance and Preventive Maintenance Program (B.2.7)

TABLE 3.5-2
AGING MANAGEMENT PROGRAMS FOR CONTAINMENT, STRUCTURES AND COMPONENT SUPPORTS THAT ARE NOT ADDRESSED IN NUREG-1801

Row Number	Component Types	Material	Environment	AERMs	Program/Activity
3.5.2.18	Flood panel seals	Neoprene	Plant Indoor Air	Change in Material Properties • Due to the prolonged exposure of neoprene to temperatures above 95 deg F	Periodic Surveillance and Preventive Maintenance Program (B.2.7)
3.5.2.19	Flood panel seals	Neoprene	Plant Indoor Air	Cracking • Due to the prolonged exposure of neoprene to temperatures above 95 deg F	Periodic Surveillance and Preventive Maintenance Program (B.2.7)
3.5.2.20	Manhole foam blocks	Polyurethane foam	Ambient Air Protected from Weather	Cracking • Due to vibration, movement, and shrinkage:	Periodic Surveillance and Preventive Maintenance Program (B.2.7)
3.5.2.21	Manhole foam blocks	Polyurethane foam	Ambient Air Protected from Weather	Separation • Due to vibration, movement, and shrinkage:	Periodic Surveillance and Preventive Maintenance Program (B.2.7)
3.5.2.22	Auxiliary building pressure relief panels	PVC	Outside Air	Change in Material Properties • Due to ultraviolet (UV) radiation exposure:	Structures Monitoring Program (B.2.10)
3.5.2.23	Auxiliary building pressure relief panels	PVC	Outside Air	Cracking • Due to ultraviolet (UV) radiation exposure:	Structures Monitoring Program (B.2.10)

TABLE 3.5-2
AGING MANAGEMENT PROGRAMS FOR CONTAINMENT, STRUCTURES AND COMPONENT SUPPORTS THAT ARE NOT ADDRESSED IN NUREG-1801

Row Number	Component Types	Material	Environment	AERMs	Program/Activity
3.5.2.24	Intake Structure stainless steel raw water pump gland bolting	Stainless Steel	Raw Water	Loss of Material • Crevice corrosion due to the presence of dissolved oxygen and impurities. • MIC due to exposure to microbiological activity • Pitting corrosion due to (1) stagnant or low-flow conditions , and (2) halide ions, chlorides, bromides or hypochlorites.	General Corrosion of External Surfaces Program (B.3.3)
3.5.2.25	Structural steel	Stainless Steel	Ambient Air	None	Not Applicable
3.5.2.26	Trisodium phosphate baskets	Stainless Steel	Ambient Air	None	Not Applicable
3.5.2.27	Boot clamps for auxiliary building boot sealed fire penetration barrier	Stainless Steel	Ambient Air	None	Not Applicable
3.5.2.28	Structural steel, fuel transfer penetration, fasteners	Stainless Steel	Borated treated water	*Cracking* Loss of Material • Crevice corrosion due to an oxygenated treated water environment • Pitting corrosion due to exposure to halogens and sulfates.	Structures Monitoring Program (B.2.10) and Inservice Inspection Program (B.1.3)
3.5.2.29	Not used in application				

TABLE 3.5-2
AGING MANAGEMENT PROGRAMS FOR CONTAINMENT, STRUCTURES AND COMPONENT SUPPORTS THAT ARE NOT ADDRESSED IN NUREG-1801

Row Number	Component Types	Material	Environment	AERMs	Program/Activity
3.5.2.30	Radiant energy shield sheet metal	Carbon Steel	Ambient Air	Loss of Material General corrosion due to the exposure of external surfaces to varying levels of humidity.	Fire Protection Program (B.2.5)
3.5.2.31	Component Support Stainless Structural Steel	Stainless Steel	Borated treated water	Cracking Stress corrosion cracking	Chemistry Program (B.1.2)
3.5.2.32	Not used in application.				
3.5.2.33	Intake Structure concrete exposed to raw water	Concrete	Raw Water	Loss of Material Abrasion	Structures Monitoring Program (B.2.10)

Red & Italics – Review based changes
Blue & Bold – RAI based changes (NONE)

TABLE 3.5-3
Components in Structures and Component Supports not Evaluated in NUREG-1801 that Rely on Aging Management Programs in NUREG-1801 for FCS License Renewal

Row Number	FCS Components	FCS Material	FCS Environment	FCS AERMs	FCS Program Activity	Applicable NUREG-1801 AMR Results Row Number	Justification for applying NUREG-1801 Aging Management Review Results
3.5.3.01	Intake Structure bronze sluice gate operator gland and gland bolting	Bronze	Raw Water	Loss of Material Due to dezincification	Selective Leaching Program (B.3 6)	3.3.1.16 3.3.1.24	The FCS components are made of the same material, exposed to the same environment, subject to the same aging effects and managed by the same aging management program as the components evaluated in NUREG-1801 VII.C1.2-a
3.5.3.02	Steel spring support anchorage	Carbon Steel	Indoor ambient air	Loss of Material General corrosion	Structures Monitoring Program (B.2.10)	3.5.1.25	The FCS components are made of the same material, exposed to the same environment, subject to the same aging effects and managed by the same aging management program as the components evaluated in NUREG-1801 III.B4.1-a
3.5.3.03	Reactor cavity liner, reactor cavity seal ring, fuel transfer penetration, *component supports*	Stainless Steel	Plant Indoor Air/Borated Water	Loss of Material, Cracking	Water Chemistry Program (B.1.2) and Monitoring of spent fuel pool water level	3.5.1.19	The FCS components are made of the same material, exposed to the same environment, subject to the same aging effects and managed by the same aging management program as the components evaluated in NUREG-1801 III.A5.2-b

TABLE 3.5-3
Components in Structures and Component Supports not Evaluated in NUREG-1801 that Rely on Aging Management Programs in NUREG-1801 for FCS License Renewal

Row Number	FCS Components	FCS Material	FCS Environment	FCS AERMs	FCS Program Activity	Applicable NUREG-1801 AMR Results Row Number	Justification for applying NUREG-1801 Aging Management Review Results
3.5.3.04	Containment Ungrouted Masonry Block Walls in Ambient Air	Masonry	Plant Indoor Air	Cracking	Structures Monitoring Program	3.5.1.20	The FCS components are made of the same material, exposed to the same environment, subject to the same aging effects and managed by the same aging management program as the components evaluated in NUREG-1801 III.A3 3-a.

Red and Italics – Review based changes
Blue and Bold – RAI based changes (NONE)

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Appendix B

+71/F296

OMAHA PUBLIC POWER DISTRICT
FORT CALHOUN STATION
30TH YEAR (8TH PERIOD)
CONTAINMENT TENDON SURVEILLANCE

PRECISION SURVEILLANCE CORPORATION
IN-SERVICE INSPECTION
QUALITY CONTROL PROCEDURE

GENERAL EXTERIOR CONTAINMENT CONCRETE INSPECTION

⚠ Prepared by H.F. Hendrickson PER TELCON RAK Title MGR. Q.A. Date 8-17-01

⚠ Approved by P.C. SMITH Title PROJ. MGR. Date 8-17-01

⚠ Approved by R.D. Hough Title G.M. Date 8-17-01

F72 / F2960

1. PURPOSE

This procedure will establish the requirements for the visual inspection of the exposed accessible exterior surfaces at Omaha Public Power District's Fort Calhoun Station containment building during the 30th Year (8th Period) In-Service Inspection (surveillance) of the post-tensioning system.

2. SCOPE

The exterior surfaces of the containment shall be visually examined to detect areas of large spall, severe scaling, D-cracking in an area of **25** square feet or more, other surface deterioration or disintegration, or grease leakage. The terms "large spall", "severe scaling", "D-cracking", "deterioration" and "disintegration" are as defined in the American Concrete Institute publication, ACI 201.1R-68, "Guide for Making a Condition Survey of Concrete in Service".

Portions of the concrete surface that are covered by the liner, foundation material, or backfill, or are otherwise obstructed by adjacent structures, components, parts, or appurtenances are exempt from the examination requirements.

All accessible grease cans shall be visually examined to detect significant grease leakage or grease can deformation.

3. RESPONSIBILITY

PSC Quality Control personnel to be responsible for performing the visual inspections required of this procedure.

Omaha Public Power District's Responsible Professional Engineer (RPE) to be responsible for evaluation and disposition of any deficiencies recorded as a result of the inspections performed.

4. QUALIFICATIONS

PSC Quality Control personnel are to be certified in accordance with the ASME Code, Section XI, Subsection IWA-23 13 (Employer's Written Practice comparable to CP-189, 1991 Edition). Certification levels shall be comparable to CP-189 for training experience, and exams including vision tests or as qualified by Omaha Public Power District's Responsible Professional Engineer.

5. QUALITY CONTROL

This procedure contains no HOLD POINTS. All Quality Control Documentation (QCD) points shall only require documentation of information or evaluation data. The required information or evaluation data shall be documented on Data Sheet 8.4 and Sketch Sheet 8.4.

1 8-17-01 NO CHANGE

6. EQUIPMENT

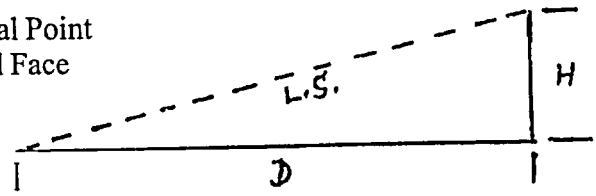
Optical aids and artificial lighting shall be used as directed by the RPE.

7. PREREQUISTES

Visual aids such as binocular, transit and artificial light shall be used according to the following table for visual distances and height.

Naked Eye		Binocular (8x23)		Transit (30x42)	
L.S. (50'-0" max.)		L.S. (200'-0" max.)		L.S. (300'-0" max.)	
H	D max	H	D max	H	D max
45'-0"	21'-6"	190'-0"	62'-0"	220'-0"	203'-0"
30'-0"	40'-0"	90'-0"	178'-6"	110'-0"	279'-0"
10'-0"	49'-0"	10'-0"	199'-6"	20'-0"	299'-0"

H = Height up or down from Visual Point
D = Maximum distance from Wall Face
L.S. = Line of Sight



To demonstrate and verify that the inspector can complete the general inspection, two different gray paper charts with line pairs of 0.030", 0.050", 0.075" and 0.130" will be used at Line of Sight maximum distance.

⚠ To incorporate Field Change Request No. FCR FN780-01, dated 8/14/01, for documentation of remote inspection equipment and clarifications of Gray Cards and use of artificial lighting refer to attachments A and B to this Procedure.

8. VISUAL EXAMINATION

The concrete surface, including coated areas, shall be visually examined for evidence of conditions, such as defined in ACI 201.1, Guide for Making a Condition Survey of Concrete in Service, which may be indicative of damage or degradation.

The examination may be performed from floors, roofs, platforms, walkways, ladders, ground surface, and other permanent vantage points unless temporary close-in access to suspect areas of concrete surface is required by the RPE.

8.1. QCD- If any area is found to have spalling, scaling, surface deterioration, surface disintegration, grease leakage or cracks over 0.030" a detailed inspection shall be completed. All areas with D-cracking of any size shall be documented on Data Sheet 8.4 and any area of spalling, scaling and cracking over 0.030" shall be sketched on Sketch Sheet 8.4.

⚠ 8-17-01 ADD INFO.

F74/F296

8.1.1. Detailed inspection shall be performed directly at a distance of 2'0" maximum and 50 fc (minimum) illumination or equivalent to determine the extent and severity of the distress or degradation and documented on Sketch Sheet 8.4. The RPE shall be notified of all areas of detailed inspection for his review at completion.

8.2. The condition of the concrete surface is acceptable if the RPE determines that there is no evidence of damage or degradation sufficient to warrant further evaluation or repair.

9. NOTIFICATION

9.1 The Omaha Public Power District Responsible Professional Engineer shall be formally notified of the completion and the results of this general visual examination.

9.1.1 Items with examination results that are not acceptable by the RPE shall be evaluated by Omaha Public Power District. Omaha Public Power District shall be responsible for preparation of an Engineering Evaluation Report stating the following:

(a) the cause of the condition which does not meet the acceptance standards;

(b) the acceptability or the concrete containment without repair of the item;

(c) whether or not repair is required and, if required, the extent, method, and completion date for the repair;

(d) extent, nature, and frequency of additional examinations.

10. DOCUMENTATION

Data Sheet 8.4 and as applicable Sketch Sheet 8.4 shall be used for documenting the requirements of this procedure.

11. ATTACHMENTS

11.1 Data Sheet 8.4

11.2 Sketch Sheet 8.4

11.3 Gray Paper Sheet

11.4 ACI 201.1R-68, "Guide for Making a Condition Survey of Concrete in Service"

⚠ 11.5. Attachment A (Letter Dated 8/10/01 for Demonstration of remote inspection equipment)

⚠ 11.6. Attachment B (Clarifications of Gray Cards and use of artificial lighting)

⚠ 8-17-01 ADD INFO.

PROJECT: FORT CALHOUN STATION SURVEILLANCE NO. 8TH YEAR 30TH

GENERAL EXTERIOR CONTAINMENT CONCRETE INSPECTION

INSPECTION AREA	hspection Method Used _____
Helical Wall Tendon Access Gallery, Including Grease Cans 0^0 TO 90^0	OBSERVATIONS: (Identify and attach any Sketch Sheets generated.) DEFICIENCIES PER ACI 201.1: Inspected By: _____ Date: _____ Reviewed By: _____ Date: _____

LIC-03-0035

Appendix C

VIII. COMPARISON WITH ORIGINAL INSTALLATION DATA

A comparison of the liftoff forces from this surveillance to the original installation lock-off forces is made in an effort to detect any evidence of system degradation. The lock-off forces are compared in order to detect any abnormal force loss which would possibly indicate an underestimation of the creep, shrinkage and/or elastic shortening effects in the Containment Building. This comparison is summarized in detail in table XII.

The losses for the tendon groups were found to be 22.7% for the helical tendons and 25.3% for the dome tendons. Based upon the results from other facilities in comparison with Fort Calhoun the losses are as expected for a containment of this age and do not indicate any degradation of the system.

A regression analysis was conducted on both tendon groups, helical and dome, and the graphs are shown on the following pages. The input data for force, test dates and elapsed time from original stressing are shown after the graphs. The analysis indicates both groups being above the design minimum requirements beyond the next scheduled surveillance. Projections to 40 years after installation (38 years of plant life) show the helical forecast at 618 kips and the domes at 620 kips. This is 34 kips above the minimum of 584 kips for the helical tendons and 31 kips above the minimum of 589 for the dome tendons.

The common tendons for both the helical and dome tendons have changed throughout the history of the plant. Tendons H-1018, H-2121 and D-301P have been tested during the three most recent surveillances. The data points from these surveillances are not sufficient for a regression analysis. However, the forces for these three tendons recorded from this surveillance are within +0.19%, -0.18% and -2.5%, respectively, of the calculated regression curve. This variance from the regression curve should not be alarming. The hydraulic rams used for collecting the data have a possible 1.5% error within themselves. When comparing the recorded forces from the 6th, 7th & 8th surveillances, it can be seen by the data that the forces have leveled out and losses are at a minimum, if any. This indicates the losses in the tendon have dissipated with time as originally expected.

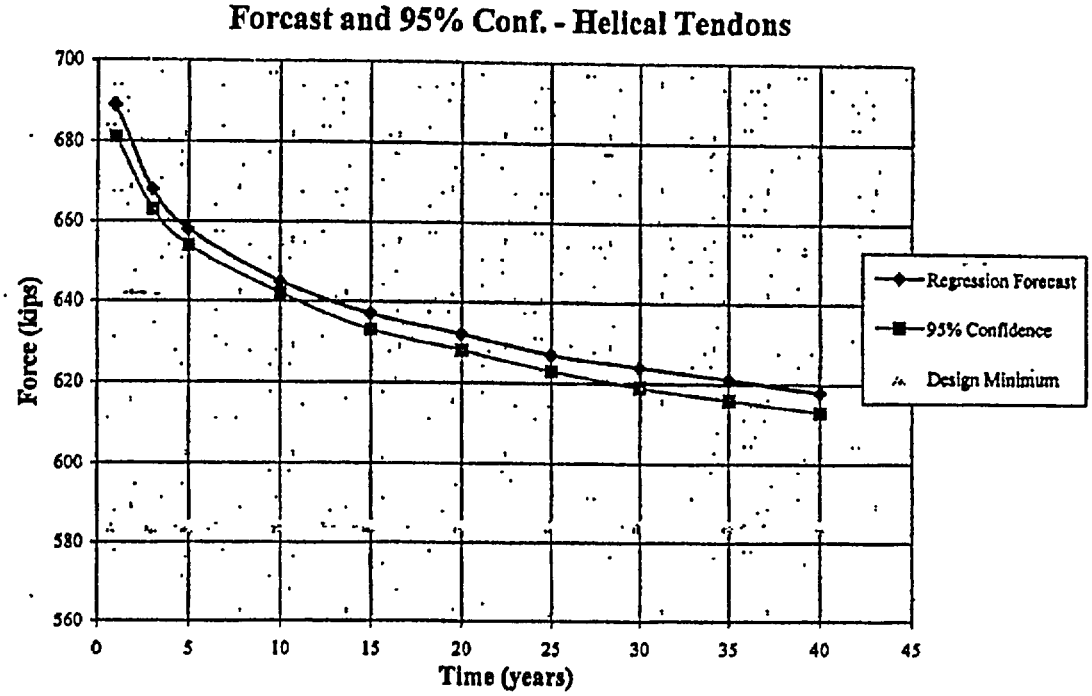
OMAHA PUBLIC POWER DISTRICT
FORT CALHOUN STATION
30TH YEAR (8TH PERIOD)
CONTAINMENT TENDON SURVEILLANCE

TABLE XIII: COMPARISON OF ORIGINAL LOCKOFF FORCES TO AS FOUND FORCES

TENDON	LIFTOFF FORCE		LOSS (kips)	PERCENTAGE %	AVERAGE PERCENTAGE
	ORIGINAL	@25 YEARS			
H-1001	770.3	646.8	123.5	19.1	22.7
H-1018	765.8	625.2	140.6	22.5	
H-2075	787.8	651	136.8	21.0	
H-2121	789.8	622.8	167.0	26.8	
H-2124	780.3	628	152.3	24.3	
H-2132	795.7	642.3	153.4	23.9	
H-3041	791.7	640.5	151.2	23.6	
H-3083	773.3	619	154.3	24.9	
H-3132	801.3	637	164.3	25.8	
H-3152	779.8	639.5	140.3	21.9	
H-4038	762.1	641.5	120.6	18.8	
H-4086	777.0	651.4	125.6	19.3	
D-129N	806.9	701.7	105.2	15.0	25.3
D-215N	806.9	623.4	183.5	29.4	
D-301P	792.0	608.4	183.6	30.2	
D-312N	777.0	614.4	162.6	26.5	

OMAHA PUBLIC POWER DISTRICT
FORT CALHOUN STATION
30TH YEAR (8TH PERIOD)
CONTAINMENT TENDON SURVEILLANCE

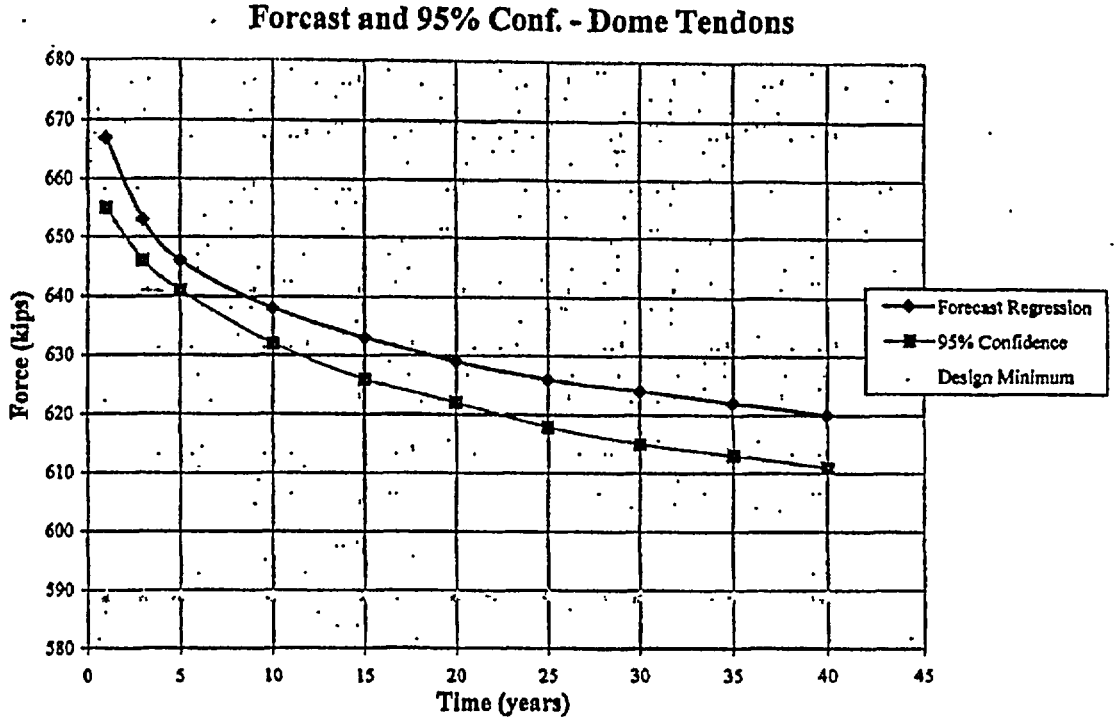
HELICAL REGRESSION FORECAST



HELICAL TENDONS			
YEARS	FORECAST (kips)	95% Confidence	Design Min.
1	689	681	584
3	668	663	584
5	658	654	584
10	645	642	584
15	637	633	584
20	632	628	584
25	627	623	584
30	624	619	584
35	621	616	584
40	618	613	584

OMAHA PUBLIC POWER DISTRICT
FORT CALHOUN STATION
30TH YEAR (8TH PERIOD)
CONTAINMENT TENDON SURVEILLANCE

DOME REGRESSION FORECAST



DOME TENDONS			
YEARS	FORECAST (kips)	95% Confidence	Design Min.
1	667	655	589
3	653	646	589
5	646	641	589
10	638	632	589
15	633	626	589
20	629	622	589
25	626	618	589
30	624	615	589
35	622	613	589
40	620	611	589

OMAHA PUBLIC POWER DISTRICT
FORT CALHOUN STATION
30TH YEAR (8TH PERIOD)
CONTAINMENT TENDON SURVEILLANCE

REGRESSION ANALYSIS DATA

SERIES	TENDON	LIFT-OFF FORCE (KIPS)	DATE TESTED	ORIGINAL STRESS	TIME ELAPSED (YEARS)
8TH	H- 1001	646.80	10/15/01	07/25/72	29.244
8TH	H- 1018	625.20	10/15/01	08/08/72	29.205
8TH	H- 2075	651.00	10/16/01	07/21/72	29.258
8TH	H- 2121	622.80	10/11/01	07/10/72	29.274
8TH	H- 2124	628.00	10/11/01	07/11/72	29.271
8TH	H- 2132	642.30	10/11/01	06/29/72	29.304
8TH	H- 3041	640.50	10/12/01	07/07/72	29.285
8TH	H- 3083	619.00	10/11/01	07/10/72	29.274
8TH	H- 3132	637.00	12/10/01	06/29/72	29.468
8TH	H- 3152	639.50	10/15/01	07/21/72	29.255
8TH	H- 4038	641.50	10/12/01	08/12/72	29.186
8TH	H- 4086	651.40	10/11/01	08/05/72	29.203
8TH	D- 129N	701.70	11/28/01	09/01/72	29.26
8TH	D- 215N	623.40	11/27/01	08/29/72	29.266
8TH	D- 301P	608.40	11/20/01	09/01/72	29.238
8TH	D- 312N	614.40	12/06/01	09/02/72	29.279

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30TH YEAR (8TH PERIOD)
CONTAINMENT TENDON SURVEILLANCE

REGRESSION ANALYSIS DATA

SERIES	TENDON	LIFT-OFF FORCE (KIPS)	DATE TESTED	ORIGINAL STRESS	TIME ELAPSED (YEARS)
7TH	H- 1018	616.15	08/27/96	08/08/72	24.068
7TH	H- 1101	651.20	08/23/96	08/09/72	24.055
7TH	H- 2002	629.70	08/26/96	07/07/72	24.153
7TH	H- 2015	633.90	09/05/96	07/13/72	24.164
7TH	H- 2048	629.60	08/24/96	07/11/72	24.137
7TH	H- 2110	628.10	08/24/96	07/20/72	24.112
7TH	H- 2121	619.10	08/21/96	07/10/72	24.132
7TH	H- 3121	619.60	08/21/96	07/10/72	24.132
7TH	H- 3122	630.70	08/23/96	07/10/72	24.137
7TH	H- 3151	635.90	09/04/96	07/21/72	24.14
7TH	H- 3152	630.40	08/23/96	07/21/72	24.107
7TH	H- 4111	652.22	09/06/96	08/02/72	24.112
7TH	D- 113S	652.70	12/12/96	08/31/72	24.299
7TH	D- 203P	636.10	12/13/96	08/28/72	24.31
7TH	D- 301P	616.40	12/10/96	09/01/72	24.29
7TH	D- 325N	627.70	01/08/97	09/01/72	24.37

OMAHA PUBLIC POWER DISTRICT
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CONTAINMENT TENDON SURVEILLANCE

Omaha Public Power District

REGRESSION ANALYSIS DATA

SERIES	TENDON	LIFT-OFF FORCE (KIPS)	DATE TESTED	ORIGINAL STRESS	TIME ELAPSED (YEARS)
6TH	H- 1018	620.50	10/30/91	08/08/72	19.238
6TH	H- 1046	616.60	10/31/91	07/27/72	19.274
6TH	H- 1058	622.60	10/28/91	07/28/72	19.263
6TH	H- 2029	619.00	10/25/91	07/19/72	19.279
6TH	H- 2121	620.50	10/26/91	07/10/72	19.307
6TH	H- 2145	621.70	11/06/91	07/19/72	19.312
6TH	H- 3008	623.00	11/04/91	07/11/72	19.329
6TH	H- 3105	631.00	10/28/91	06/30/72	19.34
6TH	H- 4141	609.40	10/26/91	07/31/72	19.249
6TH	H- 4154	631.30	10/26/91	08/12/72	19.216
6TH	D- 119P	618.60	02/03/92	08/29/72	19.444
6TH	D- 120P	645.00	01/29/92	09/05/72	19.411
6TH	D- 218N	604.00	02/05/92	09/05/72	19.43
6TH	D- 301P	615.60	02/07/92	09/01/72	19.447
6TH	D- 318P	620.60	01/31/92	09/04/72	19.419

OMAHA PUBLIC POWER DISTRICT
FORT CALHOUN STATION
30TH YEAR (8TH PERIOD)
CONTAINMENT TENDON SURVEILLANCE

Omaha Public Power District

REGRESSION ANALYSIS DATA

SERIES	TENDON	LIFT-OFF FORCE (KIPS)	DATE TESTED	ORIGINAL STRESS	TIME ELAPSED (YEARS)
5TH	H- 1046	629.00	10/23/85	07/27/72	13.249
5TH	H- 1091	642.50	10/25/85	08/07/72	13.225
5TH	H- 1139	620.10	10/18/85	08/09/72	13.2
5TH	H- 2029	627.60	10/22/85	07/19/72	13.268
5TH	H- 2063	662.00	10/23/85	07/18/72	13.274
5TH	H- 2106	653.20	10/14/86	07/19/72	14.247
5TH	H- 2137	622.60	10/21/85	07/14/72	13.279
5TH	H- 3014	600.60	10/22/85	07/12/72	13.288
5TH	H- 3063	654.40	10/09/86	07/18/72	14.236
5TH	H- 3100	638.80	10/28/85	07/18/72	13.288
5TH	H- 3126	654.50	10/17/85	06/27/72	13.315
5TH	H- 4054	614.80	10/23/85	08/08/72	13.216
5TH	H- 4085	651.50	10/24/85	08/05/72	13.227
5TH	H- 4151	620.10	10/21/85	08/11/72	13.203
5TH	D- 119S	609.60	11/04/85	08/29/72	13.192
5TH	D- 229N	611.10	10/31/85	09/01/72	13.173
5TH	D- 330N	606.70	10/30/85	09/05/72	13.159

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Omaha Public Power District

REGRESSION ANALYSIS DATA

SERIES	TENDON	LIFT-OFF FORCE (KIPS)	DATE TESTED	ORIGINAL STRESS	TIME ELAPSED (YEARS)
4TH	H- 1082	634.20	10/06/81	08/04/72	9.178
4TH	H- 2144	646.13	09/30/81	07/05/72	9.244
4TH	H- 3005	610.13	10/02/81	07/10/72	9.236
4TH	H- 3130	662.70	10/02/81	07/12/72	9.23
4TH	H- 4010	618.08	10/05/81	07/28/72	9.195
4TH	H- 4074	636.41	10/06/81	08/11/72	9.159
4TH	D- 118N	629.57	10/12/81	09/02/72	9.115
4TH	D- 202N	632.66	10/13/81	09/02/72	9.118
4TH	D- 329N	650.77	10/08/81	09/01/72	9.107

OMAHA PUBLIC POWER DISTRICT
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30TH YEAR (8TH PERIOD)
CONTAINMENT TENDON SURVEILLANCE

Omaha Public Power District

REGRESSION ANALYSIS DATA

SERIES	TENDON	LIFT-OFF FORCE (KIPS)	DATE TESTED	ORIGINAL STRESS	TIME ELAPSED (YEARS)
3RD	H- 1080	633.72	10/01/76	08/04/72	4.162
3RD	H- 1081	682.58	10/01/76	07/26/72	4.186
3RD	H- 1152	660.05	10/01/76	08/11/72	4.142
3RD	H- 2039	660.05	10/01/76	07/25/72	4.189
3RD	H- 2111	671.32	10/01/76	07/05/72	4.244
3RD	H- 2147	622.36	10/01/76	07/06/72	4.241
3RD	H- 3006	660.05	10/01/76	07/10/72	4.23
3RD	H- 3022	667.56	10/01/76	06/29/72	4.26
3RD	H- 3059	671.32	10/01/76	07/14/72	4.219
3RD	H- 3115	641.15	10/01/76	07/24/72	4.192
3RD	H- 4017	648.58	10/01/76	08/08/72	4.151
3RD	H- 4036	667.56	10/01/76	08/12/72	4.14
3RD	H- 4104	660.05	10/01/76	08/10/72	4.145
3RD	H- 4142	675.07	10/01/76	08/10/72	4.145
3RD	D- 102N	656.07	10/01/76	09/05/72	4.074
3RD	D- 135S	675.07	10/01/76	09/01/72	4.085
3RD	D- 216N	630.01	10/01/76	08/31/72	4.088
3RD	D- 234S	675.07	10/01/76	09/04/72	4.077
3RD	D- 303N	660.05	10/01/76	09/06/72	4.071
3RD	D- 332S	645.03	10/01/76	08/28/72	4.096

OMAHA PUBLIC POWER DISTRICT
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30TH YEAR (8TH PERIOD)
CONTAINMENT TENDON SURVEILLANCE

Omaha Public Power District

REGRESSION ANALYSIS DATA

SERIES	TENDON	LIFT-OFF FORCE (KIPS)	DATE TESTED	ORIGINAL STRESS	TIME ELAPSED (YEARS)
1ST	H- 1023	709.53	02/01/74	08/09/72	1.482
1ST	H- 1080	687.00	02/01/74	08/04/72	1.496
1ST	H- 1135	679.49	02/01/74	07/28/72	1.515
1ST	H- 2032	687.00	02/01/74	07/20/72	1.537
1ST	H- 2072	702.02	02/01/74	07/20/72	1.537
1ST	H- 2113	707.54	02/01/74	07/21/72	1.534
1ST	H- 2147	679.49	02/01/74	07/06/72	1.575
1ST	H- 3005	679.49	02/01/74	07/10/72	1.564
1ST	H- 3042	671.98	02/01/74	07/10/72	1.564
1ST	H- 3069	694.51	02/01/74	07/19/72	1.54
1ST	H- 3115	664.91	02/01/74	07/24/72	1.526
1ST	H- 4010	679.49	02/01/74	07/28/72	1.515
1ST	H- 4050	683.24	02/01/74	08/07/72	1.488
1ST	H- 4104	688.77	02/01/74	08/10/72	1.479
1ST	D- 114N	664.91	02/01/74	09/02/72	1.416
1ST	D- 114S	657.40	02/01/74	09/02/72	1.416
1ST	D- 124N	649.89	02/01/74	09/05/72	1.408
1ST	D- 216N	664.91	02/01/74	09/05/72	1.408
1ST	D- 216S	657.40	02/01/74	09/04/72	1.411
1ST	D- 318S	657.40	02/01/74	09/04/72	1.411
1ST	D- 327N	679.49	02/01/74	08/29/72	1.427

CONCLUSION

Based upon an evaluation of the In-Service Inspection results for the Thirtieth Year Physical Tendon Surveillance reported herein, PSC concludes that Fort Calhoun's Containment Structure has experienced no abnormal degradation of the post tensioning system. We also conclude, based on the calculated regression analysis, that the group average forces in the tendons will remain above the design minimum throughout the following period prior to the 35th year surveillance.

The final review of the concrete indicates no problems with any of the findings of the VT-1C inspections. A detailed summary with photos and explanations of the VT-1C inspections can be found in Attachment "A" of this report.