

## **SECTION 3 - AGING MANAGEMENT REVIEW**

### **3.0 AGING MANAGEMENT REVIEW RESULTS**

For those structures and components that are identified as being subject to an aging management review, 10 CFR 54.21(a)(3) requires demonstration that the effects of aging will be adequately managed so that their intended function(s) will be maintained consistent with the current licensing basis for the period of extended operation.

This section describes the results of the aging management reviews of the components and structures determined, during the scoping and screening processes, to be subject to an aging management review. During the screening process, some structures and components (SCs) were incorporated into commodity groups based on similarity of their design or materials of construction. Use of commodity groups made it possible to address an entire group of SCs with a single evaluation. In the aging management reviews described in the following sections, further definition of commodity groups was performed based on design, material, environmental, and functional characteristics in order to disposition an entire group with a single aging management review.

Organization of this chapter parallels Chapter 3, "Aging Management Review Results" of NUREG-1800, Standard Review Plan for the Review of License Renewal Applications for Nuclear Power Plants (NUREG-1800), dated April 2001. The major sections of this Chapter are:

- 3.1 Aging Management of Reactor Vessel, Internals, and Reactor Coolant System
- 3.2 Aging Management of Engineered Safety Features
- 3.3 Aging Management of Auxiliary Systems
- 3.4 Aging Management of Steam and Power Conversion Systems
- 3.5 Aging Management of Containments, Structures, and Component Supports
- 3.6 Aging Management of Electrical and Instrumentation and Controls

Components and structures subject to an aging management review were evaluated to demonstrate that the effects of aging will be managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation. The components, aging effects/mechanism, and aging management programs to be used for managing the effects of aging at VCSNS were compared to those listed in NUREG-1801, Generic Aging Lessons Learned, dated April 2001. The results are documented and dis-

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cussed in the following sections using the format contained in Tables 3.1-1 through 3.6-1 of NUREG-1800. Aging management programs are described in Appendix B of this application.

### **3.1 AGING MANAGEMENT OF REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM**

#### **3.1.1 SYSTEM DESCRIPTION**

VCSNS Reactor Coolant System components evaluated in this section of the application consist of the Reactor Vessel, Reactor Vessel Internals, Incore Instrumentation System, Pressurizer, Steam Generators, and associated reactor coolant system piping.

The RCS consists of three (3) closed reactor coolant loops connected in parallel to the reactor pressure vessel. Each loop contains one steam generator, one reactor coolant pump, connecting piping and instrumentation. A pressurizer is connected, via a surge line, to the A loop reactor vessel outlet (hot leg) pipe. All components of the Reactor Coolant System are located within the Reactor Building.

Portions of the Incore Nuclear Instrumentation System (thimble tube pressure boundary), Chemical and Volume Control System (regenerative heat exchanger and Reactor Coolant Pump seal injection and return lines), Safety Injection System (piping and valves), Residual Heat Removal System (piping and valves), Reactor Vessel Level Instrumentation/Inadequate Core Cooling Monitor System, and the Primary Sampling System (piping and isolation valves) are included in this section, because they form part of the Class 1 Reactor Coolant System boundary.

#### **3.1.2 AGING MANAGEMENT REVIEW**

##### **3.1.2.1 Methodology**

Aging management review of Reactor Coolant System components and commodities consisted of one of two approaches (or a combination of the two). The first was application of the methods described in Section 4.2 of NEI 95-10 [Reference 3.1-1]. The VCSNS AMR methodology follows the approach recommended in NEI 95-10 and is based on generic industry guidance for determining aging effects for both mechanical and civil/structural components. The guidance represents a set of rules that allow the evaluator to identify aging

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effects for a given material and environment combination. The material and environment-based rules in the generic industry guidance documents are derived from known age-related degradation mechanisms and industry operating experience. The guidance was reviewed for applicability to VCSNS materials of construction and component internal and external operating environments and was used to identify aging effects for components, and commodities. The results of the evaluation of materials and environment combinations, using the VCSNS methodology, are aging effects; and, if the aging effects adversely affect intended functions, the results are aging effects requiring management for the applicable components and commodities. Aging effects that require management are correlated to aging management programs.

The second approach involved applying the information contained in NRC-approved industry Generic Topical Reports applicable to Reactor Coolant System and related components. The Generic Topical Reports provide both a list of components/ commodities requiring aging management and related aging management programs.

In either case, the aging management review identifies one or more aging management programs to be used to demonstrate that the effects of aging will be managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation. The programs to be used for managing the effects of aging were compared to those listed in NUREG-1801 [Reference 3.1-2] and evaluated for consistency with NUREG-1801 programs that are relied on for license renewal. The results are documented and discussed in Table 3.1-1 using the format suggested by the NRC Standard Review Plan for License Renewal (NUREG-1800) [Reference 3.1-3]. Aging management programs are described in Appendix B of this application.

### **3.1.2.2 Operating Experience**

**Site:** VCSNS site-specific operating experience was reviewed. The site-specific operating experience included a review of (1) Corrective Action Program, (2) Licensee Event Reports, (3) Maintenance Rule Data Base, and (4) interviews with Systems Engineers. No additional aging effects requiring management were identified beyond those identified using the methods described in the previous Section.

**Industry:** An evaluation of industry operating experience published since the effective date of NUREG-1801 was performed to identify any additional aging effects requiring management. No additional aging effects requiring management were identified beyond those identified using the methods described in the previous Section.

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On-Going: On-going review of plant-specific and industry operating experience is performed in accordance with the plant Operating Experience Program.

### **3.1.3 AGING MANAGEMENT PROGRAMS**

#### **3.1.3.1 Aging Management Programs Evaluated In NUREG-1801 That Are Relied On For License Renewal**

Table 3.1-1 shows the component and commodity groups (combinations of materials and environments), and aging management programs evaluated in NUREG-1801 that are relied on for license renewal of the Reactor Coolant System. The table is based on Table 3.1-1 of NUREG-1800 and provides a discussion of the applicability of the component commodity group and details regarding the degree to which VCSNS aging management programs are consistent with those recommended in NUREG-1801. The discussion section includes (1) information regarding the applicability of NUREG-1801 component/commodity group to VCSNS, (2) any issues recommended in NUREG-1801 that require further evaluation, (3) details regarding VCSNS components to be included in the component/commodity group, and (4) any additional materials to be added to the component/commodity groups beyond those identified in NUREG-1801.

#### **3.1.3.2 Further Evaluation Of Aging Management As Recommended By NUREG-1801**

Further evaluation of aging management as recommended by NUREG-1801 has been incorporated into the "Discussion" column of Table 3.1-1. A cross-reference is provided to the section of the application where TLAAs are discussed.

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**Table 3.1-1:**  
**SUMMARY OF AGING MANAGEMENT PROGRAMS FOR THE REACTOR COOLANT SYSTEM**  
**EVALUATED IN NUREG-1801 THAT ARE RELIED ON FOR LICENSE RENEWAL**

<b>AMR Item</b>	<b>Component Group</b>	<b>Aging Effect / Mechanism</b>	<b>Aging Management Program</b>	<b>Further Evaluation Recommended</b>	<b>Discussion</b>
1	Reactor coolant pressure boundary components	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA	The TLAA is applicable to Class 1 components at VCSNS. See <b>Section 4.3</b> of this application for the TLAA discussion for fatigue of Class 1 components.
2	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	The component/component type AMR results for VCSNS are consistent with NUREG-1801 in material, environment, aging effect, and credited program. IN 90-04 which is referenced for this NUREG-1801 item as the basis for enhanced detection of aging effects in the shell, addressed flaw growth at girth welds due to service loading. IN 90-04 contains only general indication that pits on the surface served as crack initiation sites, and not that pitting corrosion resulted in sufficient degradation to cause loss of component function. No subsequent industry experience has further identified pitting corrosion resulting in reportable indications for the shell. Cracking as the

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
2 (cont.)					<p>result of flaw growth is an aging effect/mechanism that is managed at VCSNS by the ISI Plan (<b>Appendix B.1.7</b>). The Chemistry Program (<b>Appendix B.1.4</b>) manages general corrosion, pitting corrosion and crevice corrosion.</p> <p>Consistent with NUREG-1801, this group contains alloy steel portions of the Steam Generators. (Specifically the upper and lower shell and the transition cone) In addition to this, VCSNS has included the elliptical head.</p>
3	Pressure vessel ferritic materials that have a neutron fluence greater than $10^{17}$ n/cm <sup>2</sup>	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	The TLAA is applicable to loss of fracture toughness of the pressure vessel at VCSNS. See <b>Section 4.2</b> of this application for the TLAA discussion of loss of fracture toughness of the pressure vessel.

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
3 (cont.)	(E>1 MeV)				
4	Reactor vessel beltline shell and welds	Loss of fracture toughness due to neutron irradiation embrittlement	Reactor vessel surveillance	Yes, plant specific	<p>The component/component type AMR results for VCSNS are consistent with NUREG-1801 in material, environment, aging effect, and credited program. The upper shell and nozzles are not considered the limiting components for radiation embrittlement due to their physical distance from the active fuel assemblies. The Reactor Vessel Surveillance program (<b>Appendix B.1.24</b>) will manage radiation embrittlement by addressing the most limiting sub-components with respect to exposure to the greatest fluence postulated to occur during the period of extended operation.</p> <p>Consistent with NUREG-1801, this group contains stainless steel clad alloy steel reactor vessel components.</p>

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
5	Westinghouse and Babcock & Wilcox (B&W) baffle/ former bolts	Loss of fracture toughness due to neutron irradiation embrittlement and void swelling	Plant specific	Yes, plant specific	<p>The component/component type AMR results for VCSNS are consistent with NUREG-1801 in material, environment, aging effect, and credited program. The Reactor Vessel Internals Inspection program (<b>Appendix B.2.4</b>) will manage the Loss of Fracture Toughness due to Neutron irradiation Embrittlement and Void Swelling for baffle former bolts.</p> <p>Consistent with NUREG-1801, this group contains stainless steel baffle former bolts for a Westinghouse plant.</p>
6	Small-bore reactor coolant system and connected systems piping	Crack initiation and growth due to stress corrosion cracking (SCC), intergranular stress corrosion cracking (IGSCC),	Inservice inspection; water chemistry; one-time inspection	Yes, parameters monitored/ inspected and detection of aging effects are to be further evaluated	The component/component type AMR results for VCSNS are consistent with NUREG-1801 in material, environment, aging effect, and credited program. Small Bore Class 1 Piping Inspections ( <b>Appendix B.2.7</b> ), the Chemistry Program ( <b>Appendix B.1.4</b> ), and In-Service Inspection (ISI) Plan ( <b>Appendix B.1.7</b> ), are

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6 (cont.)		and thermal and mechanical loading			<p>credited for management of these aging effects, and meet the intent of the NUREG-1801 listed programs.</p> <p>Consistent with NUREG-1801, this group contains cracking of small bore ASME class 1 stainless steel piping.</p>
7	Vessel shell	Crack growth due to cyclic loading	TLAA	Yes, TLAA	<p>This group addresses a TLAA for underclad cracking of vessels with ASME SA-508 class 2 material. The vessel at VCSNS is constructed of ASME SA-533 grade B class 1 (not ASME SA-508) material, therefore this aging effect is not applicable.</p>
8	Reactor internals	Changes in dimension due to void swelling	Plant specific	Yes, plant specific	<p>The component/component type AMR results for VCSNS are consistent with NUREG-1801 in material, environment, aging effect, and credited program. Some additional reactor internals components have been included in</p>

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
8 (cont.)					<p>NUREG-1801. Materials listed in NUREG-1801 and used at VCSNS are both SS and Ni alloy. However, the clevis inserts are Ni alloy at VCSNS instead of stainless steel as specified in NUREG-1801. The credited program is Reactor Vessel Internals Inspection (<b>Appendix B.2.4</b>).</p> <p>Consistent with NUREG-1801, this group contains void swelling of the stainless steel and Ni-alloy reactor internals components. Additionally, irradiation creep is an aging mechanism affecting baffle and former bolts.</p>
9	PWR core support pads, instrument tubes (bottom head)	Crack initiation and growth due to SCC and/or primary water stress corrosion cracking (PWSCC)	Plant specific	Yes, plant specific	The component/component type AMR results for VCSNS are consistent with NUREG-1801 in material, environment and aging effect. Chemistry Program ( <b>Appendix B.1.4</b> ), Alloy 600 Aging Management Program ( <b>Appendix B.1.1</b> ) and In-Service Inspection (ISI) Plan

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
9 (cont.)	penetrations), pressurizer spray heads, and nozzles for the steam generator instruments and drains				<p>(Appendix B.1.7) are credited for management of these aging effects.</p> <p>Consistent with NUREG-1801, this group contains cracking of various Ni alloy components. At VCSNS only the core support pads and bottom head penetration tubes are included in this grouping.</p>
10	Cast austenitic stainless steel (CASS) reactor coolant system piping	Crack initiation and growth due to SCC	Plant specific	Yes, plant specific	<p>The component/component type AMR results for VCSNS are consistent with NUREG-1801 in material, environment and aging effect. NUREG-1801 recommends evaluation of a plant-specific aging management program. The Chemistry Program (Appendix B.1.4) and In-Service Inspection (ISI) Plan (Appendix B.1.7) are credited for management of these aging effects.</p>

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
10 (cont.)					Consistent with NUREG-1801, this group contains cracking and crack growth of the of cast stainless steel RCS piping and fittings.
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	<p>The component/component type AMR results for VCSNS are consistent with NUREG-1801 in material, environment, aging effect, and credited program. At VCSNS this group has been used to envelope inconel 82/182 weld metal for the pressurizer safe end rather than alloy 600 base metal for instrument penetrations and heater sleeves. Alloy 600 Aging Management Program (<b>Appendix B.1.1</b>) is credited for management of this aging effect.</p> <p>Consistent with NUREG-1801, this group contains cracking and crack growth due to primary water stress corrosion cracking of Nickel-Based Alloy Pressurizer instrument penetrations and heater sleeves.</p>

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
12	Westing-house and B&W baffle former bolts	Crack initiation and growth due to SCC and irradiation-assisted stress corrosion cracking (IASCC)	Plant specific	Yes, plant specific	<p>The component/component type AMR results for VCSNS are consistent with NUREG-1801 in material, environment and aging effect. The credited aging management programs are Reactor Vessel Internals Inspection (<b>Appendix B.2.4</b>) and Chemistry Program (<b>Appendix B.1.4</b>).</p> <p>Consistent with NUREG-1801, this group contains cracking of the reactor internals stainless steel baffle former bolts.</p>
13	Westing-house and B&W baffle former bolts	Loss of preload due to stress relaxation	Plant specific	Yes, plant specific	<p>The component/component type AMR results for VCSNS are consistent with NUREG-1801 in material, environment and aging effects. The credited aging management program is Reactor Vessel Internals Inspection (<b>Appendix B.2.4</b>).</p> <p>Consistent with NUREG-1801, this group</p>

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
13 (cont.)					contains loss of preload of the stainless steel reactor internals baffle former bolts.
14	Steam generator feedwater impingement plate and support	Loss of section thickness due to erosion.	Plant specific	Yes, plant specific	This NUREG-1801 group addresses erosion of steam generator feedwater impingement plate and supports. These components do not have a license renewal intended function for VCSNS, therefore aging management is not required.
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	Steam generator tubing integrity; water chemistry	Yes, effectiveness of a proposed AMP is to be evaluated	This group addresses cracking of various aging effect/mechanisms of steam generator tube bundles, sleeves and plugs. VCSNS has Westinghouse Delta 75 steam generators with thermally treated alloy 690 tubes. Phosphate water chemistry control has not been used at VCSNS. The credited aging management programs are the Chemistry Program ( <b>Appendix B.1.4</b> ) and Steam Generator Management Program ( <b>Appendix B.1.10</b> ).

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<b>AMR Item</b>	<b>Component Group</b>	<b>Aging Effect / Mechanism</b>	<b>Aging Management Program</b>	<b>Further Evaluation Recommended</b>	<b>Discussion</b>
15 (cont.)		and pitting corrosion, and fretting and wear; or deformation due to corrosion at tube support plate intersections			
16	Tube support lattice bars made of carbon steel	Loss of section thickness due to flow-accelerated corrosion (FAC)	Plant specific	Yes, plant specific	This NUREG-1801 group addresses erosion of steam generator tube support lattice bars. This group is applicable to Combustion Engineering steam generators and does not apply to VCSNS.
17	Carbon steel tube support plate	Ligament cracking due to corrosion	Plant specific	Yes, effectiveness of a proposed AMP is to be evaluated	This NUREG-1801 group addresses cracking of carbon steel steam generator tube supports. The tube supports at VCSNS are made of 405 stainless steel. The alloy 690 anti-vibration bars are also included in this group. The Chemistry Program ( <b>Appendix B.1.4</b> ) alone is

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
17 (cont.)					sufficient to manage cracking.
18	Reactor vessel closure studs and stud assembly	Crack initiation and growth due to SCC and/or IGSCC	Reactor head closure studs	No	<p>The component/component type AMR results for VCSNS are consistent with NUREG-1801 in material, environment and credited program. A clarification to the aging effect requiring management is required; i.e. Loss of closure integrity rather than cracking is the effect requiring management and the additional mechanism of stress relaxation being managed. The credited aging management program is Reactor Head Closure Studs Program (<b>Appendix B.1.8</b>).</p> <p>Consistent with NUREG-1801, this group contains alloy steel reactor vessel closure head bolts for PWR's.</p>

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19	CASS pump casing and valve body	Loss of fracture toughness due to thermal aging embrittlement	Inservice inspection	No	<p>The component/component type AMR results for VCSNS are consistent with NUREG-1801 in material, environment and credited program. This group addresses loss of fracture toughness (thermal embrittlement) due to thermal aging as an aging effect for cast austenitic stainless steel (CASS) where temperatures continuously exceed 482°F. The Reactor Coolant System is designed to operate at 650°F. The applicable components fabricated from CASS are certain Reactor Coolant System Class 1 valve bodies and the reactor coolant pump casing.</p> <p>The credited aging management program is the In-Service Inspection (ISI) Plan (<b>Appendix B.1.7</b>).</p> <p>Consistent with NUREG-1801, this group</p>

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
19 (cont.)					contains loss of fracture toughness of the cast stainless steel ASME class 1 pumps and valves.
20	CASS piping	Loss of fracture toughness due to thermal aging embrittlement	Thermal aging embrittlement of CASS	No	The component/component type AMR results for VCSNS are consistent with NUREG-1801 in material, environment and credited program. This group addresses loss of fracture toughness (thermal embrittlement) due to thermal aging as an aging effect for cast austenitic stainless steel (CASS) where temperatures continuously exceed 482°F. The Reactor Coolant System is designed to operate at 650°F. The applicable components fabricated from CASS are the reactor coolant loop piping elbows and the 45-degree accumulator nozzle. Additionally, the control rod drive latch housings have been included in this group. In a May 9, 2000 letter, Christopher I. Grimes, Chief License Renewal and Standardization

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<b>AMR Item</b>	<b>Component Group</b>	<b>Aging Effect / Mechanism</b>	<b>Aging Management Program</b>	<b>Further Evaluation Recommended</b>	<b>Discussion</b>
20 (cont.)					<p>Chief License Renewal and Standardization Branch clarified that not all CASS components are subject to thermal aging. The components fabricated from CASS were evaluated using the acceptance criteria set forth in the above NRC letter. The screening criteria are supported by the SER for WCAP-14575-A which concludes that if the screening criteria are met the material is determined "not susceptible" and no additional inspections or evaluations are required because the material has adequate toughness.</p> <p>Based on the material chemistry for the CASS components at VCSNS, these components are not susceptible to a loss of fracture toughness due to thermal aging. The components have low molybdenum content and have delta ferrite levels of less than 20%. Therefore an</p>

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
20 (cont.)					aging management program is not required for loss of fracture toughness (thermal embrittlement) due to thermal aging of these components.
21	BWR piping and fittings; steam generator components	Wall thinning due to flow accelerated corrosion	Flow accelerated corrosion	No	<p>This NUREG-1801 group addresses loss of material due to flow accelerated corrosion of steam generator steam and feed nozzles and safe ends.</p> <p>VCSNS has not identified flow accelerated corrosion as a valid aging mechanism for these components.</p>
22	Reactor coolant pressure boundary (RCPB) valve closure	Loss of material due to wear; loss of preload due to stress relaxation; crack initiation	Bolting integrity	No	The component/component type AMR results for VCSNS are consistent with NUREG-1801 in material and environment. VCSNS is a Westinghouse plant and only PWR and recirculating steam generator components are applicable. A clarification to the aging effect/

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
22 (cont.)	bolting, man-way and holding bolting, and closure bolting in high-pressure and high-temperature systems	and growth due to cyclic loading and/or SCC	Bolting integrity	No	<p>mechanisms requiring management is required. Loss of closure integrity rather than loss of preload or cracking is the effect requiring management and the additional mechanism of stress relaxation being managed. Wear is not considered a valid aging effect/ mechanisms requiring management for the control rod drive flange bolting. In-Service Inspection (ISI) Plan (<b>Appendix B.1.7</b>) is credited for management of these aging effects.</p> <p>Consistent with NUREG-1801, this group contains alloy steel and stainless steel class 1 bolting (other than reactor vessel closure head bolts) and steam generator class 2 bolting.</p>
23	CRD nozzle	Crack initiation and growth due to PWSCC	Ni-alloy nozzles and penetrations; water chemistry	No	The component/component type AMR results for VCSNS are consistent with NUREG-1801 in material, environment, aging effect, and

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
23 (cont.)					<p>credited programs. The credited aging management program is the Alloy 600 Aging Management Program (<b>Appendix B.1.1</b>).</p> <p>Consistent with NUREG-1801, this group contains PWSCC of Ni-alloy control rod drive head penetration nozzles.</p>
24	Reactor vessel nozzles safe ends and CRD housing; reactor coolant system components (except	Crack initiation and growth due to cyclic loading, and/or SCC, and PWSCC	Inservice inspection; water chemistry	No	<p>The component/component type AMR results for VCSNS are consistent with NUREG-1801 in material, environment, aging effect, and credited program. The pressurizer relief tank is not in-scope for VCSNS.</p> <p>Consistent with NUREG-1801, the materials include stainless steel, stainless steel clad carbon steel, Ni alloy and cast stainless steel. The NUREG-1801 Table 1 "Component" column provides an exception for cast stainless steel, however, its "Item Number In GALL"</p>

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<b>AMR Item</b>	<b>Component Group</b>	<b>Aging Effect / Mechanism</b>	<b>Aging Management Program</b>	<b>Further Evaluation Recommended</b>	<b>Discussion</b>
24 (cont.)	CASS and bolting)				<p>column includes cast stainless steel pumps and valves. VCSNS has included these components in this group.</p> <p>Consistent with NUREG-1801, the credited aging management programs are the Chemistry Program (<b>Appendix B.1.4</b>) and In-Service Inspection (ISI) Plan (<b>Appendix B.1.7</b>). Whereas both the Chemistry Program and ISI are credited, ISI for this group is primarily directed at welded connections (and thereby crack growth). As such, the Chemistry Program itself provides adequate management for the non-welded portions of components/ component types within this group (such as the RCP main closure flange and casing and the pressurizer tubing, couplings, and immersion heater well assemblies). Additionally the Alloy 600 Aging Management Program</p>

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
24 (cont.)					<p>(Appendix B.1.1) is credited for management of primary water stress corrosion of Ni-alloy.</p> <p>Consistent with NUREG-1801, this group contains cracking and crack growth of many of the Class 1 components in a PWR. In addition to the listed components, other reactor vessel components have been included in the group.</p>
25	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	No cast austenitic stainless steel reactor vessel internal components are in scope for VCSNS.
26	External surfaces of carbon steel	Loss of material due to boric acid corrosion	Boric acid corrosion	No	The component/component type AMR results for VCSNS are consistent with NUREG-1801 in material, environment, aging effect, and

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<b>AMR Item</b>	<b>Component Group</b>	<b>Aging Effect / Mechanism</b>	<b>Aging Management Program</b>	<b>Further Evaluation Recommended</b>	<b>Discussion</b>
26 (cont.)	components in reactor coolant system pressure boundary				<p>credited program. The pressurizer relief tank is not in-scope for VCSNS. The credited aging management program is Boric Acid Corrosion Surveillances (<b>Appendix B.1.2</b>).</p> <p>Consistent with NUREG-1801, this group contains boric acid corrosion of carbon (and alloy) steel reactor coolant system components.</p>
27	Steam generator secondary manways and hand-holds (carbon steel)	Loss of material due to erosion	Inservice inspection	No	This NUREG-1801 group addresses erosion of steam generator manways and hand holes of once-through steam generators. VCSNS has Westinghouse recirculating steam generators.
28	Reactor internals, reactor vessel closure studs,	Loss of material due to wear	Inservice inspection	No	The component/component type AMR results for VCSNS are consistent with NUREG-1801 in material, environment, aging effect, and credited program. The materials listed in

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
28 (cont.)	and core support pads				<p>NUREG-1801 and used at VCSNS are the same; however, the material for the clevis insert is alloy 600, instead of stainless steel. The components referenced in NUREG-1801 are the upper core plate alignment pins, vessel flange, radial keys, clevis inserts and flux thimbles. VCSNS has also included the head vessel alignment pins in this group. The Reactor Vessel Internals Inspection (<b>Appendix B.2.4</b>) is credited for reactor vessel Internals. The In-Service Inspection (ISI) Plan (<b>Appendix B.1.7</b>) is credited for the vessel flange. The Bottom Mounted Instrumentation Inspection (<b>Appendix B.1.3</b>) is credited for aging management of the bottom mounted flux thimbles.</p> <p>Consistent with NUREG-1801, this group contains wear of components (other than bolting)</p>

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<b>AMR Item</b>	<b>Component Group</b>	<b>Aging Effect / Mechanism</b>	<b>Aging Management Program</b>	<b>Further Evaluation Recommended</b>	<b>Discussion</b>
28 (cont.)					of the reactor vessel and internals components that are routinely disassembled.
29	Pressurizer integral support	Crack initiation and growth due to cyclic loading	Inservice inspection	No	<p>The component/component type AMR results for VCSNS are consistent with NUREG-1801 in material, environment, aging effect, and credited program. The credited aging management program is In-Service Inspection (ISI) Plan (<b>Appendix B.1.7</b>).</p> <p>This NUREG-1801 group addresses crack initiation and growth of the pressurizer integral support.</p>
30	Upper and lower internals assembly (Westinghouse)	Loss of preload due to stress relaxation	Inservice inspection; loose part and/or neutron noise monitoring	No	<p>The component/component type AMR results for VCSNS are consistent with NUREG-1801 in material, environment, and aging effect. The Reactor Vessel Internals Inspection (<b>Appendix B.2.4</b>) is credited for reactor vessel Internals. VCSNS does not credit Loose Parts</p>

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
30 (cont.)					<p>Monitoring or Neutron Noise Monitoring.</p> <p>Consistent with NUREG-1801, this group contains loss of preload of the stainless steel holddown spring and the Ni-alloy clevis insert bolts.</p>
31	Reactor vessel internals in fuel zone region (except Westinghouse and B&W baffle former bolts)	Loss of fracture toughness due to neutron irradiation embrittlement and void swelling	PWR vessel internals; water chemistry	No	<p>The component/component type AMR results for VCSNS are consistent with NUREG-1801 in material, environment, and aging effect. VCSNS is a Westinghouse plant and only the Westinghouse components are applicable. The Reactor Vessel Internals Inspection program (<b>Appendix B.2.4</b>) will manage the loss of fracture toughness for applicable components. The Chemistry Program is not credited for managing loss of fracture toughness.</p> <p>Consistent with NUREG-1801, this group contains loss of fracture toughness due to</p>

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<b>AMR Item</b>	<b>Component Group</b>	<b>Aging Effect / Mechanism</b>	<b>Aging Management Program</b>	<b>Further Evaluation Recommended</b>	<b>Discussion</b>
31 (cont.)					irradiation embrittlement in components in close proximity to the core.
32	Steam generator upper and lower heads, tubesheets, and primary nozzles and safe ends	Crack initiation and growth due to SCC, PWSCC, and/or IASCC	Inservice inspection; water chemistry	No	<p>The component/component type AMR results for VCSNS are consistent with NUREG-1801 in material, environment, aging effect, and credited program. NUREG-1801 group only identifies the steam generator primary side nozzles and safe ends. VCSNS has included all of the primary side of the steam generator except tubes, plug and sleeves. VCSNS is a Westinghouse plant and has recirculating steam generator. The credited aging management programs are Chemistry Program (<b>Appendix B.1.4</b>), In-Service Inspection Plan (<b>Appendix B.1.7</b>) and Alloy 600 Aging Management Program (<b>Appendix B.1.1</b>).</p> <p>Consistent with NUREG-1801, this group contains cracking of steam generator primary</p>

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
32 (cont.)					nozzles and safe ends.
33	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	<p>The component/component type AMR results for VCSNS are consistent with NUREG-1801 in material, environment, aging effect, and credited program. VCSNS is a Westinghouse plant and only Westinghouse components are applicable. there is difference in material. The clevis inserts are alloy 600 at VCSNS instead of stainless steel as shown in NUREG-1801. Head/vessel alignment pins, secondary core support and spray nozzles for upper plenum cooling, are being included in this item. Although they are not addressed in this NUREG-1801 group, with respect to material, environment, aging effect requiring management, and credited program the sub-component AMR results are consistent with NUREG-1801. The Reactor Vessel Internals Inspection</p>

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<b>AMR Item</b>	<b>Component Group</b>	<b>Aging Effect / Mechanism</b>	<b>Aging Management Program</b>	<b>Further Evaluation Recommended</b>	<b>Discussion</b>
33 (cont.)					<p>program (<b>Appendix B.2.4</b>) and the Chemistry Program (<b>Appendix B.1.4</b>) will manage crack initiation and growth in these components.</p> <p>Consistent with NUREG-1801, this group contains crack initiation and growth of the stainless steel and Ni-alloy reactor internals except baffle former bolts.</p>
34	Reactor vessel closure studs and stud assembly and stud assembly	Loss of material due to wear	Reactor head closure studs	No	<p>The component/component type AMR results for VCSNS are consistent with NUREG-1801 in material, environment, aging effect, and credited program. The credited program is Reactor Head Closure Studs Program (<b>Appendix B.1.8</b>).</p> <p>Consistent with NUREG-1801, this group contains wear of the alloy steel reactor vessel closure stud assembly.</p>

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
35	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	<p>The component/component type AMR results for VCSNS are consistent with NUREG-1801 in material, environment, aging effect, and credited program. Material used at VCSNS is stainless steel. NUREG-1801 lists both stainless steel and Ni alloy. Whereas NUREG-1801 specifies the ASME Section XI ISI and Loose Parts Monitoring, VCSNS credits only the Reactor Vessel Internals Inspection (<b>Appendix B.2.4</b>).</p> <p>Consistent with NUREG-1801, this group contains loss of preload of the stainless steel reactor internals upper and lower support column bolts.</p>

### **3.1.3.3 Aging Management Evaluations That Are Different From Or Not Addressed In NUREG-1801**

Aging Management Evaluations that are different from or not addressed in NUREG-1801 are identified and discussed in Table 3.1-2. The standard six-column format has been utilized. The discussion column provides additional details regarding the aging management conclusions reached by VCSNS for the component type.

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**Table 3.1-2:**  
**SUMMARY OF AGING MANAGEMENT EVALUATIONS FOR THE REACTOR COOLANT SYSTEM**  
**THAT ARE DIFFERENT FROM OR NOT ADDRESSED IN NUREG-1801 BUT ARE RELIED ON FOR LICENSE RENEWAL**

AMR Item	Component Type	Material	Environment	Aging Effect / Mechanism	Program/Activity	Discussion
1	Piping and piping system components	Stainless Steel (including Cast Austenitic Stainless Steel)	Air-gas (moist air)	None Identified	None Required	This grouping includes external surfaces of stainless steel piping system components exposed to a moist air environment. At VCSNS, the ambient environment does not contain contaminants of sufficient concentration to cause aging effects that require aging management.
2	Piping and piping system components	Nickel-Based Alloy, Stainless Steel with Nickel-Based Weld	Air-gas (moist air)	None Identified	None Required	This grouping includes external surfaces of Nickel-Based Alloy piping system components exposed to a moist air environment. At VCSNS, the ambient environment does not contain contaminants of sufficient concentration to cause

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AMR Item	Component Type	Material	Environment	Aging Effect / Mechanism	Program/Activity	Discussion
2 (cont.)						aging effects that require aging management.
3	Steam Generator Components (Other than Shell - Upper and Lower Barrel, Transition Cone, Elliptical Head)	Carbon Steel	Treated Water	Loss of Material/ Crevice Corrosion, General Corrosion, Pitting Corrosion, Galvanic Corrosion	Chemistry Program	This grouping includes carbon steel components exposed to the treated water/ steam environment inside the steam generator. VCSNS has determined the Chemistry Program ( <b>Appendix B.1.4</b> ) provides adequate management for these secondary side components of the steam generator, which are not specifically addressed in NUREG-1801 chapter IV.
4	Instrumentation (Pressure)	Stainless Steel	Reactor Building	Loss of Mechanical Closure Integrity/ Stress	In-Service Inspection (ISI) Plan	Loss of mechanical closure integrity due to stress relaxation, stress corrosion

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AMR Item	Component Type	Material	Environment	Aging Effect / Mechanism	Program/Activity	Discussion
4 (cont.)	Retaining Only) - Incore Thermocouples Seal			Relaxation, Wear		<p>cracking, and or wear of bolted closures is an aging effect requiring evaluation for the in-core thermocouple seal assemblies. Stress relaxation (loss of preload) of bolting materials is a concern at the elevated temperatures at which the Reactor Coolant System operates. Stress corrosion cracking is a concern for high strength bolting (&gt; 150 ksi) materials in Class 1 closure applications. Wear of bolted closures is a concern due to relative motion during infrequent (periodic) disassembly and reassembly operations. The</p>

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AMR Item	Component Type	Material	Environment	Aging Effect / Mechanism	Program/Activity	Discussion
4 (cont.)						In-Service Inspection (ISI) Plan ( <b>Appendix B.1.7</b> ) is credited for management of these aging effects.
5	Piping and piping system components	Stainless Steel	Chemically Treated Borated Water	Loss of Material due to Crevice Corrosion, Pitting Corrosion	Chemistry Program	This grouping includes stainless steel piping and piping system components in chemically treated borated water. The Chemistry Program ( <b>Appendix B.1.4</b> ) alone provides aging management for loss of material of stainless steel in chemically treated borated water environment.
6	Piping and piping system components	Stainless Steel	Chemically Treated Borated Water	Crack Initiation and Growth/ Stress Corrosion Cracking	Chemistry Program	This grouping includes stainless steel piping and piping system components in chemically treated

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AMR Item	Component Type	Material	Environment	Aging Effect / Mechanism	Program/Activity	Discussion
6 (cont.)						borated water. The Chemistry Program ( <b>Appendix B.1.4</b> ) alone provides aging management for cracking of stainless steel in a chemically treated borated water environment.
7	Reactor Internals components, Reactor vessel, Pressurizer, RCP, Incore thermocouple seal	Stainless Steel and Ni-alloy	Chemically Treated Borated Water	Loss of Material due to Crevice Corrosion, Pitting Corrosion	Chemistry Program	This grouping includes stainless steel and Ni-alloy Reactor Coolant System components in chemically treated borated water. The Chemistry Program ( <b>Appendix B.1.4</b> ) alone provides aging management for loss of stainless steel material in chemically treated borated water environment.

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AMR Item	Component Type	Material	Environment	Aging Effect / Mechanism	Program/Activity	Discussion
8	Steam Generator Secondary Side Thermal Sleeves, Steam Flow Limiter	Nickel-Based Alloy (Alloy 690 TT)	Treated Water	Loss of Material due to Crevice Corrosion, Pitting Corrosion	Chemistry Program	This grouping includes Ni-alloy steam generator secondary side components. The Chemistry Program ( <b>Appendix B.1.4</b> ) provides adequate management for loss of material of these secondary side components of the steam generator in a treated water environment, which are not specifically addressed in GALL chapter IV.
9	Steam Generator Secondary Side Thermal Sleeves, Steam Flow Limiter	Nickel-Based Alloy (Alloy 690 TT)	Treated Water	Crack Initiation and Growth/ Stress Corrosion Cracking, Flaw Growth at Welds	Chemistry Program, The In-Service Inspection (ISI) Plan	This grouping includes Ni-alloy steam generator secondary side components. The Chemistry Program ( <b>Appendix B.1.4</b> ) and the In-Service Inspection (ISI) Plan ( <b>Appendix B.1.7</b> )

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AMR Item	Component Type	Material	Environment	Aging Effect / Mechanism	Program/Activity	Discussion
9 (cont.)						provide adequate management for cracking of these secondary side components of these steam generator in a treated water environment, which are not specifically addressed in GALL chapter IV.
10	Steam Generator Feedwater Distribution Pipe & Fittings	Alloy Steel (Chrome Moly)	Treated Water	Loss of Material due to Crevice Corrosion, Pitting Corrosion; Crack initiation and growth/ Stress corrosion cracking	Chemistry Program, The In-Service Inspection (ISI) Plan	This grouping includes alloy feedwater distribution components. The Chemistry Program ( <b>Appendix B.1.4</b> ) and the In-Service Inspection (ISI) Plan ( <b>Appendix B.1.7</b> ) provide adequate management for loss of material and cracking of these secondary side components of the steam generator.

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AMR Item	Component Type	Material	Environment	Aging Effect / Mechanism	Program/Activity	Discussion
11	Reactor Internals components, Reactor vessel, Pressurizer, RCP, Incore thermocouple seal	Stainless Steel and Nickel-Based Alloy	Chemically Treated Borated Water	Crack Initiation and Growth/ Stress Corrosion Cracking	Chemistry Program	This grouping includes stainless steel and Ni-alloy Reactor Coolant System components in chemically treated borated water. The Chemistry Program ( <b>Appendix B.1.4</b> ) alone provides aging management for cracking of stainless steel and Ni-alloy in a chemically treated borated water environment.
12	Capillary tubes and associated components	Stainless Steel	Treated Water	None Identified	None Required	This group includes stainless steel capillary tubes and associated components exposed to treated water and is consistent in material and environment with NUREG-1801 closed-cycle cooling water

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AMR Item	Component Type	Material	Environment	Aging Effect / Mechanism	Program/Activity	Discussion
12 (cont.)						<p>components. However, at VCSNS, no aging effects were determined to require management due to no means of oxygen or other contaminant entry existing for the deaerated distilled water inside these capillary tubes and associated components.</p>
13	<p>Tube Support Plates - Plates, AVBs, Flow Distribution Baffle - Secondary Side for Steam Generators</p>	<p>Stainless Steel / Nickel Based Tips &amp; Rings</p>	<p>Treated Water</p>	<p>Loss of Material due to Crevice Corrosion, Pitting Corrosion; Crack Initiation and Growth/ Stress Corrosion Cracking, Primary Water Stress Corrosion Cracking)</p>	<p>Chemistry Program</p>	<p>This grouping includes stainless steel Ni-alloy steam generator components in treated water. The Chemistry Program (<b>Appendix B.1.4</b>) alone provides aging management for loss of material and cracking of stainless steel and Ni-alloy in a</p>

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**Table 3.1-2:**  
**SUMMARY OF AGING MANAGEMENT EVALUATIONS FOR THE REACTOR COOLANT SYSTEM**  
**THAT ARE DIFFERENT FROM OR NOT ADDRESSED IN NUREG-1801 BUT ARE RELIED ON FOR LICENSE RENEWAL**

AMR Item	Component Type	Material	Environment	Aging Effect / Mechanism	Program/Activity	Discussion
13 (cont.)						treated water/ steam environment.
14	Piping and piping system components	Stainless Steel	Treated Water	Loss of Material due to Crevice Corrosion, Pitting Corrosion	Chemistry Program	This grouping includes stainless steel piping and associated components exposed to treated water from the Reactor Makeup Water system for Pressurizer Relief Tank spray. It is consistent in material and environment, aging effect and credited program with NUREG-1801 closed-cycle cooling water components. The Chemistry Program (Appendix B.1.4) provides adequate management for this component, material and environment that is not specifically addressed in

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AMR Item	Component Type	Material	Environment	Aging Effect / Mechanism	Program/Activity	Discussion
14 (cont.)						NUREG-1801 chapter IV.
15	Piping and piping system components	Stainless Steel	Air-gas	None Identified	None Required	This grouping includes the internal surfaces of stainless steel piping system components exposed to a gas environment that is not subject to wetting. The gas environment does not contain contaminants of sufficient concentration to cause aging effects that require aging management.

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**3.1.4 REFERENCES**

3.1-1	NEI 95-10, Industry Guideline for Implementing the Requirements of 10 CFR Part 54 - The License Renewal Rule, Nuclear Energy Institute, Revision 3, March 2001.
3.1-2	NUREG-1801, "Generic Aging Lessons Learned Report," Volumes 1 and 2, NRC, April 2001.
3.1-3	NUREG-1800, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants," NRC, April 2001.

## 3.2 AGING MANAGEMENT OF ENGINEERED SAFETY FEATURES

### 3.2.1 SYSTEM DESCRIPTION

Engineered Safety Features (ESF) are provided to mitigate the consequences of postulated accidents up to and including a design basis accident as discussed in **Chapter 15 of the FSAR**. The ESF systems provided for VCSNS have sufficient redundancy and independence of components and power sources that, under postulated accident conditions, the following are accomplished:

1. Core cooling limits the core thermal transient, thereby preventing excessive metal-water reactions and maintaining coolable core geometry.
2. Reactor Building structural integrity is maintained.
3. Radiation dose to the public is maintained within the limits of 10 CFR 100.

The ESF systems include the following systems:

- Chemical and Volume Control System
- Containment Isolation System
- Hydrogen Removal System
- Reactor Building Spray System
- Refueling Water System
- Residual Heat Removal System
- Safety Injection System

### 3.2.2 .AGING MANAGEMENT REVIEW

#### 3.2.2.1 Methodology

Aging management review of Engineered Safety Features System components and commodities involved consideration and evaluation of the materials, environments, and stressors that are associated with each component, or commodity grouping under review, as discussed in Section 4.2 of NEI 95-10 [**Reference 3.2-1**]. The VCSNS AMR methodology follows the approach recommended in NEI 95-10 and is based on generic industry guidance for determining aging effects for both mechanical and civil/structural components. The guidance represents a set of rules that allow the evaluator to identify aging effects for a given material and environment combination. The material and environment-based rules in the

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generic industry guidance documents are derived from known age-related degradation mechanisms and industry operating experience. The guidance was reviewed for applicability to VCSNS materials of construction and component internal and external operating environments and was used to identify aging effects for components, structures, and commodities. The results of the evaluation of materials and environment combinations, using the VCSNS methodology, are aging effects; and, if the aging effects adversely affect intended functions, the results are aging effects requiring management for the applicable components and commodities. Aging effects that require management are correlated to aging management programs.

The aging management review identifies one or more aging management programs to be used to demonstrate that the effects of aging will be managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation. The programs to be used for managing the effects of aging were compared to those listed in NUREG-1801 [Reference 3.2-2] and evaluated for consistency with NUREG-1801 programs that are relied on for license renewal. The results are documented and discussed in Table 3.2-1 using the format suggested by the NRC Standard Review Plan for License Renewal (NUREG-1800) [Reference 3.2-3].

### **3.2.2.2 Operating Experience**

- Site:** VCSNS site-specific operating experience was reviewed. The site-specific operating experience included a review of (1) Corrective Action Program, (2) Licensee Event Reports, (3) Maintenance Rule Data Base, and (4) interviews with Systems Engineers. No additional aging effects requiring management were identified beyond those identified using the methods described in the previous Section.
- Industry:** An evaluation of industry operating experience published since the effective date of NUREG-1801 was performed to identify any additional aging effects requiring management. No additional aging effects requiring management were identified beyond those identified using the methods described in the previous Section.
- On-Going:** On-going review of plant-specific and industry operating experience is performed in accordance with the plant Operating Experience Program.

### **3.2.3 AGING MANAGEMENT PROGRAMS**

#### **3.2.3.1 Aging Management Programs Evaluated In NUREG-1801 That Are Relied On For License Renewal**

Table 3.2-1 shows the component and commodity groups (combinations of materials and environments) and aging management programs evaluated in NUREG-1801 that are relied on for license renewal of the Engineered Safety Features Systems. The table is based on Table 3.2-1 of NUREG-1800 [Reference 3.2-3] and provides a discussion of the applicability of the component commodity group and details regarding the degree to which VCSNS aging management programs are consistent with those recommended in NUREG-1801. The discussion section includes (1) information regarding the applicability of NUREG-1801 component/commodity group to VCSNS, (2) any issues recommended in NUREG-1801 that require further evaluation, (3) details regarding VCSNS components to be included in the component/commodity group, and (4) any additional materials to be added to the component/commodity groups beyond those identified in NUREG-1801.

#### **3.2.3.2 Further Evaluation Of Aging Management As Recommended By NUREG-1801**

Further evaluation of aging management as recommended by NUREG-1801 has been incorporated into the "Discussion" column of Table 3.2-1. A cross-reference is provided to the section of the application where TLAA's are discussed.

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**EVALUATED IN NUREG-1801 THAT ARE RELIED ON FOR LICENSE RENEWAL**

AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
1	Piping, fittings, and valves in emergency core cooling system	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA	The TLAA is applicable to Class 2 and 3 piping systems at VCSNS. See Section 4.3.2 for the TLAA discussion of Class 2 and 3 piping systems. VCSNS is a Westinghouse PWR plant.
2	Components in containment spray (PWR only), standby gas treatment system (BWR only), containment isolation, and emergency core cooling systems	Loss of material due to general corrosion	Plant specific	Yes, plant specific	<p>The VCSNS Containment Spray System is made of stainless steel, rather than carbon steel.</p> <p>Four systems at VCSNS have been identified whose only license renewal function is to provide containment isolation. These systems are: Auxiliary Coolant (Closed Loop) / CRDM Cooling Water (AC), Demineralized Water - Nuclear Service (DN), RB Leak Rate Testing (LR) and Nitrogen Blanketing (NG). AC, LR, and NG contain carbon steel components in scope. Inspections for Mechanical</p>

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
2 (cont.)					<p>Components (<b>Appendix B.2.11</b>) are credited for detecting and managing the loss of material due to general corrosion on the external surfaces of carbon steel components. The air-gas environments inside NG and LR components do not contain contaminants of sufficient concentration to cause general corrosion severe enough to warrant managing. The Chemistry Program (<b>Appendix B.1.4</b>) is credited with providing aging management of corrosion of the interior of AC System components.</p> <p>Consistent with NUREG-1801, this group contains carbon steel in ambient air, and treated water environments. Additionally compressed gas is included in this group.</p>
3	Components in	Loss of material due to pitting and	Plant specific	Yes, plant specific	This group contains the Refueling Water Storage Tank (RWST) and systems whose only

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
3 (cont.)	containment spray (PWR only), standby gas treatment system (BWR only), containment isolation, and emergency core cooling systems	crevice corrosion	Plant specific	Yes, plant specific	<p>license renewal function is to provide containment isolation.</p> <p>VCSNS has determined that loss of material of the underside of the RWST is not an aging effect requiring management as this stainless steel tank is not buried.</p> <p>Four systems at VCSNS have been identified whose only license renewal function is to provide containment isolation. These systems are: AC, DN, LR and NG. Pitting and crevice corrosion does not require aging management for the exterior environments of stainless steel components. Inspections for Mechanical Components (<b>Appendix B.2.11</b>) is credited for detecting and managing the loss of material due to pitting, crevice, and galvanic corrosion on the external surfaces of carbon steel</p>

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**EVALUATED IN NUREG-1801 THAT ARE RELIED ON FOR LICENSE RENEWAL**

AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
3 (cont.)					<p>components. The air-gas environments inside NG and LR components do not contain contaminants of sufficient concentration to cause pitting and crevice corrosion severe enough to warrant managing. The Chemistry Program (<b>Appendix B.1.4</b>) is credited with providing aging management of corrosion of the interior of AC and DN System components.</p> <p>Consistent with NUREG-1801, this group contains both carbon and stainless steel in ambient air, and treated water environments. Additionally compressed gas is included in this group.</p>
4	Containment isolation valves and associated piping	Loss of material due to microbially influenced corrosion (MIC)	Plant specific	Yes, plant specific	Microbiologically influenced corrosion has been determined not to be a valid aging effects/mechanisms for the component/component type material and environment combination represented by this group. The four

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
4 (cont.)					systems at VCSNS that have been identified to provide containment isolation are not subject to wetting from raw water. These systems are: AC, DN, LR and NG.
5	High-pressure safety injection (charging) pump mini-flow orifice	Loss of material due to erosion	Plant specific	Yes, plant specific	NUREG-1801 V.D1.2-c addresses Emergency Core Cooling System orifices. The component/component type AMR results are consistent with the identified GALL item in material and environment. However, the identified GALL item recommends plant specific evaluation of the credited program. VCSNS considers this aging effect/mechanism a design problem, and does not have an identified aging management program for erosion of mini-flow orifices.
6	External surface of carbon steel	Loss of material due to general corrosion	Plant specific	Yes, plant specific	The component/component type AMR results for VCSNS are consistent with NUREG-1801 in material, environment, aging effect and

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
6 (cont.)	components				<p>credited program.</p> <p>Consistent with NUREG-1801, this group contains the external surfaces of carbon steel components. In addition to carbon steel, VCSNS has included cast iron in this group.</p> <p>Consistent with NUREG-1801, the aging mechanism for this group is general corrosion.</p> <p>NUREG-1801 recommends a plant specific evaluation of the credited program. The credited program/activity at VCSNS is Inspections for Mechanical Components (<b>Appendix B.2.11</b>).</p>
7	Piping and fittings of CASS in emergency	Loss of fracture toughness due to thermal aging embrittlement	Thermal aging embrittlement of CASS	No	The component/component type AMR results for VCSNS are not consistent with NUREG-1801 in material, environment, aging effect and program. VCSNS does not have cast

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
7 (cont.)	core cooling systems				stainless steel in ESF Systems subject to temperatures over 482°F.
8	Components serviced by open-cycle cooling system	Loss of material due to general, pitting, and crevice corrosion, MIC, and biofouling; buildup of deposit due to biofouling	Open-cycle cooling water system	No	The component/component type AMR results for VCSNS are not consistent with NUREG-1801 in material, environment, aging effect and program. VCSNS component/component type AMR results for components serviced by open-cycle cooling systems are contained in Auxiliary Systems, <b>Section 3.3</b> .
9	Components serviced by closed-cycle cooling system	Loss of material due to general, pitting, and crevice corrosion	Closed-cycle cooling water system	No	The component/component type AMR results for VCSNS are consistent with NUREG-1801 in material, environment and aging effect. NUREG-1801 recommends a closed cycle cooling program. The credited program/activity at VCSNS is the Chemistry Program ( <b>Appendix B.1.4</b> ). The Chemistry Program has been in effect since initial plant startup

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
9 (cont.)					<p>and has proven effective in maintaining systems' chemistry and detecting abnormal conditions. A review of operating experience confirms the effectiveness of the Chemistry Program to manage aging effects when continued into the period of extended operation. A verification program is, therefore, not warranted for the components/ component types in this group. The aging mechanisms for this group include loss of material due to general corrosion, crevice corrosion and pitting corrosion. In addition to these aging mechanisms, stress corrosion cracking is managed for this group at VCSNS.</p> <p>Consistent with NUREG-1801, this group includes carbon steel and stainless steel components in borated or treated water environments.</p>

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<b>AMR Item</b>	<b>Component Group</b>	<b>Aging Effect / Mechanism</b>	<b>Aging Management Program</b>	<b>Further Evaluation Recommended</b>	<b>Discussion</b>
9 (cont.)					<p>Consistent with NUREG-1801, this group includes heat exchanger components. VCSNS does not utilize heat exchangers in the Containment Spray System (Reactor Building Spray System at VCSNS). Some components may also be shown or listed in Auxiliary Systems, <b>Section 3.3</b>.</p>
10	Pumps, valves, piping and fittings, and tanks in containment spray and emergency core cooling system	Crack initiation and growth due to SCC	Water chemistry	No	<p>The component/component type AMR results for VCSNS are consistent with NUREG-1801 in material, environment and aging effects. The credited program/activity at VCSNS is the Chemistry Program (<b>Appendix B.1.4</b>).</p> <p>Consistent with NUREG-1801, this group includes stainless steel and stainless steel cladding in borated or treated water environments.</p>

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
10 (cont.)					<p>Consistent with NUREG-1801, this group includes stress corrosion cracking of stainless steel and stainless steel clad pumps, valves, piping, fittings and tanks. In addition to this aging mechanism, crevice and pitting corrosion are also managed for this group at VCSNS.</p>
11	Carbon steel components	Loss of material due to boric acid corrosion corrosion	Boric acid corrosion	No	<p>The component/component type AMR results for VCSNS are consistent with NUREG-1801 in material, environment, aging effect and credited program. The credited program/activity at VCSNS is Boric Acid Corrosion Surveillances (<b>Appendix B.1.2</b>).</p> <p>Consistent with NUREG-1801, this group contains external surfaces of carbon and low alloy steel components/component types in an ambient air environment, where there is a potential for leaking and dripping of chemically</p>

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<b>AMR Item</b>	<b>Component Group</b>	<b>Aging Effect / Mechanism</b>	<b>Aging Management Program</b>	<b>Further Evaluation Recommended</b>	<b>Discussion</b>
11 (cont.)					treated borated water onto component surfaces.
12	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	Loss of mechanical closure integrity is not considered an aging effect requiring evaluation for Non-Class 1 component bolted closures within the scope of license renewal at VCSNS. As such, the specific bolting/fastener materials of subject components/component types within the scope of license renewal were not itemized as a separate Non-Class 1 component/component type. Rather, bolting was treated as a "piece-part" (or sub-component/sub-part) of Non-Class 1 components/component types.

### **3.2.3.3 Aging Management Evaluations That Are Different From Or Not Addressed In NUREG-1801**

Aging Management Evaluations that are different from or not addressed in NUREG-1801 are identified and discussed in Table 3.2-2. The standard six-column format has been utilized. The discussion column provides additional details regarding the aging management conclusions reached by VCSNS for the component type.

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<b>AMR Item</b>	<b>Component Type</b>	<b>Material</b>	<b>Environment</b>	<b>Aging Effect / Mechanism</b>	<b>Program/Activity</b>	<b>Discussion</b>
1	Piping and piping system components (This includes tanks pump casings filter housings and heat exchanger components.)	Stainless Steel (including Cast)	Air-gas	None Identified	None Required	This grouping includes internal and external surfaces of stainless steel piping system components exposed to non-corrosive gas environment. At VCSNS, the ambient environment of the yard and sheltered environments do not contain contaminants of sufficient concentration to cause aging effects that require aging management.
2	Piping and piping system components	Carbon Steel	Air-gas (dry)	None Identified	None Required	This grouping includes external surfaces of carbon steel piping system components exposed to air that are not subject to wetting. It also includes the internal surface of these

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AMR Item	Component Type	Material	Environment	Aging Effect / Mechanism	Program/Activity	Discussion
2 (cont.)						components when exposed to dry air or non-corrosive process gasses.
3	Recombiner H <sub>2</sub>	Nickel-based Alloy	Air-gas	None Identified	None Required	This grouping contains the Post-accident H <sub>2</sub> recombiner. Nickel-based alloys do not require aging management in the air environment of the Reactor Building.
4	Piping and piping system components	Carbon Steel, copper-nickel	Oil	None Identified	None Required	This grouping includes oil-coated surfaces of system components exposed to lubricating oil that are not subject to wetting. These components are various components in the RCP lube oil systems that are continuously in service.

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AMR Item	Component Type	Material	Environment	Aging Effect / Mechanism	Program/Activity	Discussion
5	Reactor Building Spray components associated with NaOH addition Piping and piping system components	Stainless Steel, Carbon Steel	Treated Water (Less Than 140°F with Caustic)	Loss of Material/ General Corrosion (carbon steel only), Crevice Corrosion, Pitting Corrosion; Cracking/ Stress Corrosion Cracking	Chemistry Program and Above Ground Tank Inspection	Consistent with NUREG-1801 for non-ESF systems, the Chemistry Program ( <b>Appendix B.1.4</b> ) is credited for management of the specified aging effects in the associated caustic treated water environment. However, due to the lack of oxygen control in the supply to the Sodium Hydroxide Storage Tank a one-time inspection is required as part of the Above Ground Tank Inspection ( <b>Appendix B.2.1</b> ) at VCSNS to ensure that carbon steel portions are not experiencing sufficient degradation to cause loss of intended

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AMR Item	Component Type	Material	Environment	Aging Effect / Mechanism	Program/Activity	Discussion
5 (cont.)						function during the period of extended operation.
6	Capillary tubes and associated components	Stainless Steel	Treated Water	None Identified	None Required	This group includes stainless steel capillary tubes and associated components exposed to treated water and is consistent in material and environment with NUREG-1801 closed-cycle cooling water components. However, at VCSNS, no aging effects were determined to require management due to no means of oxygen or other contaminant entry existing for the deaerated distilled water inside these capillary tubes and associated components.

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AMR Item	Component Type	Material	Environment	Aging Effect / Mechanism	Program/Activity	Discussion
7	Refueling Water Storage Tank (including attached piping)	Stainless Steel	Treated Water	Loss of Material due to Crevice Corrosion, Pitting Corrosion; Cracking Due To Corrosive Impacts Of Alternate Wetting And Drying	Chemistry Program, Above Ground Tank Inspection	The components in the grouping are partially consistent with a NUREG-1801 Engineered Safety Feature item with respect to material, environment, aging effect requiring management and aging management program (Chemistry Program). However, additional aging effects require management at VCSNS for this ESF grouping. NUREG-1801 does not address the corrosive impacts of alternate wetting and drying of vented tanks (or tanks without a cover gas) that could concentrate contaminants

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**Table 3.2-2:**  
**SUMMARY OF AGING MANAGEMENT EVALUATIONS FOR THE ENGINEERED SAFETY FEATURES**  
**THAT ARE DIFFERENT FROM OR NOT ADDRESSED IN NUREG-1801 BUT ARE RELIED ON FOR LICENSE RENEWAL**

AMR Item	Component Type	Material	Environment	Aging Effect / Mechanism	Program/Activity	Discussion
7 (cont.)						<p>above bulk fluid concentrations and result in further degradation.</p> <p>The Chemistry Program (<b>Appendix B.1.4</b>) will manage the conditions required for a loss of material or cracking of the components in this grouping to occur in bulk fluid concentrations. In addition, the one-time Above Ground Tank Inspection (<b>Appendix B.2.1</b>) will manage the corrosive impacts of alternate wetting and drying to occur in stainless steel in the treated water environment. These programs,</p>

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<b>AMR Item</b>	<b>Component Type</b>	<b>Material</b>	<b>Environment</b>	<b>Aging Effect / Mechanism</b>	<b>Program/Activity</b>	<b>Discussion</b>
7 (cont.)						when continued into the period of extended operation, will provide reasonable assurance that the component intended function(s) will be maintained under all CLB conditions.

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**3.2.4 REFERENCES**

3.2-1	NEI 95-10, Industry Guideline for Implementing the Requirements of 10 CFR Part 54 - The License Renewal Rule, Nuclear Energy Institute, Revision 3, March 2001.
3.2-2	NUREG-1801, "Generic Aging Lessons Learned Report," Volumes 1 and 2, NRC, April 2001.
3.2-3	NUREG-1800, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants," NRC, April 2001.

### **3.3 AGING MANAGEMENT OF AUXILIARY SYSTEMS**

#### **3.3.1 SYSTEM DESCRIPTION**

The Auxiliary Systems are those systems used to support normal and emergency plant operations. The systems provide cooling, ventilation, sampling and other required functions.

The Auxiliary Systems include the following systems:

- Air Handling and Local Ventilation and Cooling Systems
- Boron Recycle System
- Chilled Water System
- Component Cooling Water System
- Diesel Generator Services Systems
- Fire Service System
- Fuel Handling System
- Gaseous Waste Processing System
- Instrument Air Supply System
- Liquid Waste Processing System
- Nuclear Plant Drains
- Non-Nuclear Plant Drains
- Nuclear Sampling System
- Radiation Monitoring System
- Reactor Makeup Water Supply System
- Roof Drains System
- Station Service Air System
- Service Water System
- Spent Fuel Cooling System
- Thermal Regeneration System

#### **3.3.2 AGING MANAGEMENT REVIEW**

##### **3.3.2.1 Methodology**

Aging management review (AMR) of Auxiliary Systems components and commodities involved consideration and evaluation of the materials, environments, and stressors that are associated with each component, or commodity grouping under review, as discussed in Section 4.2 of NEI 95-10 [Reference 3.3-1]. The VCSNS AMR methodology follows the approach recommended in NEI 95-10 and is based on generic industry guidance for deter-

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mining aging effects for both mechanical and civil/structural components. The guidance represents a set of rules that allow the evaluator to identify aging effects for a given material and environment combination. The material and environment-based rules in the generic industry guidance documents are derived from known age-related degradation mechanisms and industry operating experience. The guidance was reviewed for applicability to VCSNS materials of construction and component internal and external operating environments and was used to identify aging effects for components, structures, and commodities. The results of the evaluation of materials and environment combinations, using the VCSNS methodology, are aging effects; and, if the aging effects adversely affect intended functions, the results are aging effects requiring management for the applicable components and commodities. Aging effects that require management are correlated to aging management programs.

The aging management review identifies one or more aging management programs to be used to demonstrate that the effects of aging will be managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation. The programs to be used for managing the effects of aging were compared to those listed in NUREG-1801 [Reference 3.3-2] and evaluated for consistency with NUREG-1801 programs that are relied on for license renewal. The results are documented and discussed in Table 3.3-1 using the format suggested by the NRC Standard Review Plan for License Renewal (NUREG-1800) [Reference 3.3-3].

### **3.3.2.2 Operating Experience**

- Site: VCSNS site-specific operating experience was reviewed. The site-specific operating experience included a review of (1) Corrective Action Program, (2) Licensee Event Reports, (3) Maintenance Rule Data Base, and (4) interviews with Systems Engineers. No additional aging effects requiring management were identified beyond those identified using the methods described in the previous Section.
- Industry: An evaluation of industry operating experience published since the effective date of NUREG-1801 was performed to identify any additional aging effects requiring management. No additional aging effects requiring management were identified beyond those identified using the methods described in the previous Section.
- On-Going: On-going review of plant-specific and industry operating experience is performed in accordance with the plant Operating Experience Program.

### **3.3.3 AGING MANAGEMENT PROGRAM**

#### **3.3.3.1 Aging Management Programs Evaluated In NUREG-1801 That Are Relied On For License Renewal**

Table 3.3-1 shows the component and commodity groups (combinations of materials and environments), and aging management programs evaluated in NUREG-1801 that are relied on for license renewal of the Auxiliary Systems. The table is based on Table 3.3-1 of NUREG-1800 [Reference 3.3-3] and provides a discussion of the applicability of the component commodity group and details regarding the degree to which VCSNS aging management programs are consistent with those recommended in NUREG-1801. The discussion section includes (1) information regarding the applicability of NUREG-1801 component/commodity group to VCSNS, (2) any issues recommended in NUREG-1801 that require further evaluation, (3) details regarding VCSNS components to be included in the component/commodity group, and (4) any additional materials to be added to the component/commodity groups beyond those identified in NUREG-1801.

#### **3.3.3.2 Further Evaluation Of Aging Management As Recommended By NUREG-1801**

Further evaluation of aging management as recommended by NUREG-1801 has been incorporated into the "Discussion" column of Table 3.3-1. A cross-reference is provided to the section of the application where TLAA's are discussed.

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**Table 3.3-1:  
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 EVALUATED IN NUREG-1801 THAT ARE RELIED ON FOR LICENSE RENEWAL**

AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
1	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 combinations of components, materials, and environments identified in NUREG-1801 are not applicable to VCSNS. There are no carbon steel components with elastomer linings in the Spent Fuel Cooling System that are used to perform a license renewal intended function.
2	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	The component /component type AMR results for VCSNS are consistent with NUREG-1801 in material, environment, and partially consistent in aging effects. The VCSNS plant specific program for managing aging is Inspections for Mechanical Components ( <b>Appendix B.2.11</b> ). This program inspects external surfaces. It is expected that the aging effects for these components/component types will be exhibited on external surfaces before being exhibited on internal surfaces, therefore an aging management program that

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<b>AMR Item</b>	<b>Component Group</b>	<b>Aging Effect / Mechanism</b>	<b>Aging Management Program</b>	<b>Further Evaluation Recommended</b>	<b>Discussion</b>
2 (cont.)					<p>detects and manages only aging effects of the external surfaces is sufficient. Also, loss of material due to wear is not considered an aging effect requiring management at VCSNS because mechanical components must perform their License Renewal intended functions without moving parts. Wear that occurs on non-moving components is considered to be caused by improper design and should be corrected by normal maintenance activities.</p> <p>Consistent with NUREG-1801, this group includes elastomers in an air environment. Consistent with NUREG-1801, this group includes flexible collars between ducts and fans.</p> <p>In addition to the Air Handling System, this group includes components/component types</p>

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
2 (cont.)					from the Diesel Generator System, where these components/component types are similar and the above discussions apply.
3	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	The TLAA on fatigue is applicable to Class 2 and 3 piping systems, which includes the Chemical and Volume Control System at VCSNS. Refer to <b>Section 4.3.2</b> of this application for the discussion of fatigue of Class 2 and 3 piping systems. The VCSNS fuel handling cranes are adequately analyzed and designed for fatigue through the term of extended operation. Refer to <b>Section 4.7.3.3</b> of this application.
4	Heat exchangers	Crack initiation and growth due to	Plant specific	Yes, plant specific	The component/component type AMR results for VCSNS are consistent with NUREG-1801

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<b>AMR Item</b>	<b>Component Group</b>	<b>Aging Effect / Mechanism</b>	<b>Aging Management Program</b>	<b>Further Evaluation Recommended</b>	<b>Discussion</b>
4 (cont.)	in reactor water cleanup system (BWR); high pressure pumps in chemical and volume control system (PWR)	SCC or cracking	Plant specific	Yes, plant specific	<p>in material, environment, and aging effects. The VCSNS plant specific program for managing aging is the Chemistry Program (<b>Appendix B.1.4</b>). Consistent with NUREG-1801, the aging mechanism for this group is stress corrosion cracking. In addition, crevice corrosion and pitting corrosion are also managed for this group at VCSNS.</p> <p>Non-Class 1 Closure bolting is considered to be a piece-part of the components/component types as a whole at VCSNS. Therefore a bolting integrity program is not credited for aging management. As a piece-part of subject components/component types at VCSNS, the specific bolting/fastener materials were not itemized as a separate Non-Class 1 component or component type. Additionally, for carbon and alloy steel components, the aging</p>

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
4 (cont.)					<p>management program credited for managing external general corrosion of the applicable components/component types (e.g. Inspections for Mechanical Components [<b>Appendix B.2.11</b>]) will also inherently address their fasteners, thus requiring no separate action.</p> <p>Consistent with NUREG-1801, this group includes stainless steel in a chemically treated borated water environment. Consistent with NUREG-1801, this group includes pump casings.</p>
5	Components in ventilation systems, diesel fuel oil system, and emergency diesel	Loss of material due to general, pitting, and crevice corrosion, and MIC	Plant specific	Yes, plant specific	The component/component type AMR results for VCSNS are consistent with NUREG-1801 in material, environment, and partially consistent in aging effects. The VCSNS plant specific programs/activities for managing aging are: Inspections for Mechanical Components ( <b>Appendix B.2.11</b> ), Maintenance Rule

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
5 (cont.)	generator systems; external surfaces of carbon steel components				Structures Program ( <b>Appendix B.1.18</b> ), Boric Acid Corrosion Surveillances ( <b>Appendix B.1.2</b> ), Preventive Maintenance Activities - Ventilation Systems Inspections ( <b>Appendix B.1.26</b> ), and Diesel Generator Inspections ( <b>Appendix B.2.2</b> ). Consistent with NUREG-1801, the aging mechanisms for this group include general corrosion, pitting corrosion, and external MIC. In addition to these aging mechanisms, boric acid corrosion, galvanic corrosion, heat exchanger fouling due to particulates, and alternate wetting and drying are managed for this group at VCSNS. For surfaces in contact with air or gas, crevice corrosion is not considered to be an aging mechanism at VSCNS because contaminants are not of sufficient concentration in the air or gas environments to initiate the mechanism. For carbon steel, thick-walled components

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
5 (cont.)					<p>(≥3/8 inch) in the dry air-gas environments of the diesel generator system, general corrosion is conservatively estimated to reduce wall thickness by only 39 mils over the 60 year life of the plant, therefore, this aging mechanism will not affect the ability of these components to perform their intended functions and no program is needed to manage general corrosion of these components. At VCSNS, MIC is not considered to be an airborne contaminant, therefore, internal MIC in ventilation systems is not considered to be an aging mechanism.</p> <p>Consistent with NUREG-1801, this group includes carbon steel, galvanized steel, and copper-nickel in air or gas environments. In addition to these materials, this group includes copper, iron, cast iron, and ductile iron at VCSNS.</p>

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5 (cont.)					<p>Consistent with NUREG-1801, this group includes components in ventilation systems, diesel fuel oil systems, emergency diesel generator systems, and external surfaces of carbon steel components. In addition, this group includes components/component types from other systems where these components/component types are similar and the above discussions apply. These systems are the Fire Service System and the Component Cooling System.</p>
6	<p>Components in reactor coolant pump oil collect system of fire protection</p>	<p>Loss of material due to galvanic, general, pitting, and crevice corrosion</p>	<p>One-time inspection</p>	<p>Yes, detection of aging effects is to be further evaluated</p>	<p>Whereas NUREG-1801 concerns reactor coolant pump oil collection system components/component types that are composed of carbon steel, copper, and brass, the reactor coolant pump oil collection system components/component types at VCSNS are composed of stainless steel.</p>

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
6 (cont.)					None of the components/component types of the reactor coolant pump oil collection will collect water in low spots since all are subject to high ambient conditions which would cause evaporation of any moisture. This fact is supported by a review of the operating experience, which reveals no aging effects for these components/component types. Therefore, no aging effects were determined to require management during the period of extended operation.
7	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.	The component /component type AMR results for VCSNS are consistent with NUREG-1801 in material, environment, and partially consistent in aging effects and credited program/activity. The attributes of the credited program/activity are not fully consistent with the corresponding program attributes as described in

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
7 (cont.)					<p>NUREG-1801 because NUREG-1801 recommends augmentation of the Chemistry Program with a One-Time Inspection. The Chemistry Program (<b>Appendix B.1.4</b>) has been in effect since initial plant startup and has proven effective in maintaining systems chemistry and detecting abnormal conditions. A review of the operating experience confirms the effectiveness of the Chemistry Program (<b>Appendix B.1.4</b>) for fuel oil to manage aging effects when continued into the period of extended operation. A one-time inspection is, therefore, not warranted for these components/component types in this group. Consistent with NUREG-1801, the aging mechanisms for this group include general corrosion, pitting corrosion, crevice corrosion, and MIC. These aging mechanisms are caused by water pooling in tanks. Component/</p>

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<b>AMR Item</b>	<b>Component Group</b>	<b>Aging Effect / Mechanism</b>	<b>Aging Management Program</b>	<b>Further Evaluation Recommended</b>	<b>Discussion</b>
7 (cont.)					<p>component type AMR results for VCSNS show that water will not pool in the piping and other piping components, therefore, these aging mechanisms, with the exception of MIC, will not occur in these components. Only trace amounts of water are needed to promote MIC in fuel oil environments, so it is conservatively assumed to occur in piping and other piping components. In addition to these aging mechanisms, galvanic corrosion is managed for this group at VCSNS. These aging mechanisms will continue to be adequately managed through the period of extended operation. Bio-fouling is considered to be an aging mechanism for raw water environments only. Operating experience does not support bio-fouling in oil environments.</p> <p>Consistent with NUREG-1801, this group</p>

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<b>AMR Item</b>	<b>Component Group</b>	<b>Aging Effect / Mechanism</b>	<b>Aging Management Program</b>	<b>Further Evaluation Recommended</b>	<b>Discussion</b>
7 (cont.)					contains carbon steel in a fuel oil environment. In addition to this material, this group contains stainless steel and copper at VCSNS. Consistent with NUREG-1801, this group includes diesel fuel oil tanks in the diesel fuel oil system and emergency diesel generator system. In addition, this group includes piping and other piping components from these systems. This group also includes tanks and piping and other piping components from the Fire Service System where these components/component types are similar and the above discussions apply.
8	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	The component /component type AMR results for VCSNS are consistent with NUREG-1801 in material and environment, and partially consistent in aging effects and credited program/activity. Consistent with NUREG-1801, the aging mechanisms for this group include

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
8 (cont.)					<p>stress corrosion cracking. In addition to this aging mechanism, crevice corrosion, pitting corrosion, and heat exchanger fouling due to particulates are managed for this group at VCSNS. Cracking due to cyclic loading is not an aging effect requiring management during the period of extended operation at VCSNS. The Chemical and Volume Control System is operated continuously at steady state per design in a water-solid condition thereby precluding water hammer events; hence, there is no cyclic loading of the regenerative or let-down heat exchangers. The VCSNS plant specific program for managing aging is the Chemistry Program (<b>Appendix B.1.4</b>) which has been in effect since initial plant startup and has proven effective in maintaining systems chemistry and detecting abnormal conditions. A review of the operating experience</p>

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<b>AMR Item</b>	<b>Component Group</b>	<b>Aging Effect / Mechanism</b>	<b>Aging Management Program</b>	<b>Further Evaluation Recommended</b>	<b>Discussion</b>
8 (cont.)					<p>confirms its effectiveness in managing aging effects. A verification program is, therefore, not warranted for these components/component types in this group.</p> <p>Consistent with NUREG-1801, this group contains stainless steel in borated water and treated water environments. Consistent with NUREG-1801, this group contains the letdown and regenerative heat exchangers of the Chemical and Volume Control System.</p>
9	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	At VCSNS, the Boraflex neutron absorbing sheets will be replaced with Boral neutron absorbing sheets prior to the Refueling Outage 14 (September 2003). Boral does not degrade as a result of long-term exposure to radiation, and Boral is stable, durable, and corrosion resistant, therefore, there are no aging affects applicable to the Boral neutron

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
9 (cont.)					absorbing sheets in the spent fuel storage racks at VCSNS.
10	New fuel rack assembly	Loss of material due to general, pitting, and crevice corrosion	Structures monitoring	No	The New Fuel Rack Assembly at VCSNS does not perform an intended function and is not within scope of license renewal.
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	The AMR results for the spent fuel storage racks at VCSNS are consistent with NUREG-1801 in material, environment, aging effects, and credited programs/activities. Consistent with NUREG-1801, cracking due stress corrosion cracking is managed by the Chemistry Program ( <b>Appendix B.1.4</b> ). In addition, loss of material due to crevice corrosion and pitting corrosion are also managed by the Chemistry Program. However, the combinations of components, materials, and environments for carbon steel valves clad with stainless steel

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11 (cont.)					identified in NUREG-1801 are not applicable to VCSNS. There are no carbon steel valves clad with stainless steel in the Spent Fuel Cooling System that are used to perform a license renewal intended function.
12	Neutron absorbing sheets in spent fuel storage racks	Reduction of neutron absorbing capacity due to Boraflex degradation.	Boraflex monitoring	No	At VCSNS, the Boraflex neutron absorbing sheets will be replaced with Boral neutron absorbing sheets prior to Refueling Outage 14 (September 2003), therefore, this item is not applicable to VCSNS.
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	<p>The component/component type AMR results for VCSNS are consistent with NUREG-1801 in material, environment, aging effect, and credited program/activity.</p> <p>Consistent with NUREG-1801, this group contains carbon and low alloy steel in an air</p>

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
13 (cont.)					<p>environment. Also included in this group are aluminum, galvanized steel, brass, bronze, copper, and cast iron. Consistent with NUREG-1801, this group contains external surfaces of components. Boric Acid Corrosion Surveillances (<b>Appendix B.1.2</b>) will continue to manage boric acid corrosion of external surfaces through the period of extended operation. Loss of mechanical closure integrity is not considered to be an aging effect requiring evaluation for Non-Class 1 component bolted closures within the scope for license renewal at VCSNS. As such, the specific bolting/fastener materials of subject components/component types within the scope of license renewal were not itemized as a separate Non-Class 1 component/component type. Rather, bolting was treated as a "piece-part" (or sub-component/sub-part) of Non-Class 1 components/</p>

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<b>AMR Item</b>	<b>Component Group</b>	<b>Aging Effect / Mechanism</b>	<b>Aging Management Program</b>	<b>Further Evaluation Recommended</b>	<b>Discussion</b>
13 (cont.)					component types.
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	The component/component type AMR results in this group for VCSNS are consistent with NUREG-1801, in material, environment and aging effects (mechanisms) requiring management, as clarified. However, the Chemistry Program ( <b>Appendix B.1.4</b> ) is considered to provide adequate management in lieu of the Closed-Cycle Cooling Water System program that is recommended for this group by NUREG-1801. The Chemistry Program has been in effect since initial plant startup and has proven effective in maintaining systems chemistry and detecting abnormal conditions. A review of the operating experience confirms the effectiveness of this program to manage the conditions that could result in degradation during the period of extended operation.

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
14 (cont.)					<p>Consistent with Generic Letter 89-13, Service Water Problems Affecting Safety-Related Equipment evaluations, activities in addition to the existing chemistry controls are not warranted.</p> <p>Consistent with NUREG-1801, the component/component type AMR results in this group for VCSNS include components/component types in or serviced by closed-cycle cooling water systems. In addition, this group includes components/component types from systems that are not part of or not directly serviced by closed-cycle cooling water where the components/component types are similar and the same discussions apply. As such, the group includes components/component types from the Nuclear Sampling System, Radiation Monitoring System, Gaseous Waste</p>

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<b>AMR Item</b>	<b>Component Group</b>	<b>Aging Effect / Mechanism</b>	<b>Aging Management Program</b>	<b>Further Evaluation Recommended</b>	<b>Discussion</b>
14 (cont.)					<p>Processing System, and Reactor Coolant System (Non-Class 1 RCP thermal barrier flange and piping/tubing that are connected to the Component Cooling system).</p> <p>Consistent with NUREG-1801, this group includes carbon steel and stainless steel exposed to treated (non-borated) water at VCSNS, although NUREG-1801 indicates that heat exchanger components in this group are carbon steel, some stainless steel is in the heat exchangers in this group at VCSNS.</p> <p>Consistent with NUREG-1801, the aging effects (mechanisms) requiring management for this group include loss of material due to general (carbon steel only), crevice, and pitting corrosion. In addition to the NUREG-1801 aging effects, the following aging effects</p>

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
14 (cont.)					<p>(mechanisms) require management for applicable components/component types within this group at VCSNS:</p> <ul style="list-style-type: none"> <li>• Cracking due to stress corrosion cracking (SCC) of stainless steel in locations that conservatively have the potential to experience temperatures above 140°F during normal operation,</li> <li>• Cracking due to stress corrosion cracking (SCC) of carbon steel due to the presence of nitrite based corrosion inhibitors in the Chilled Water and Diesel Generator Cooling Water Systems,</li> <li>• Loss of material due to galvanic corrosion of carbon steel in contact with a more cathodic material, and</li> <li>• Heat exchanger tube fouling due to particulates in systems taking suction from the</li> </ul>

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14 (cont.)					bottom of a tank or reservoir.
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	<p>The VCSNS Aging Management Programs for this group are consistent with those reviewed and approved in NUREG-1801. The Material Handling System Inspection Program (<b>Appendix B.1.19</b>) is credited with managing loss of material for the steel rails and girders within the scope of license renewal, while the Maintenance Rule Structures Program (<b>Appendix B.1.18</b>) is responsible for managing the attributes associated with the aging of structures and structural components. These aging effects include loss of material due to corrosion, cracking and change in material properties, and they are detected by visual inspection of external surfaces.</p> <p>Wear is the result of movement of a material in</p>

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15 (cont.)					<p>relation to another material in contact with the first. Wear can occur during the performance of active functions. According to the License Renewal Rule [10 CFR 54.21 (a)(1)(i)], structures and components subject to an aging management review must perform their intended functions without moving parts or without a change in configuration or properties. As such, loss of material due to wear is not an aging effect requiring further evaluation for license renewal, and is only considered a consequence of frequent or rough usage.</p>
16	<p>Components in or serviced by open-cycle cooling water systems</p>	<p>Loss of material due to general, pitting, crevice, and galvanic corrosion, MIC, and biofouling; buildup of deposit due to</p>	<p>Open-cycle cooling water system</p>	<p>No</p>	<p>The component/component type AMR results for VCSNS are consistent with this NUREG-1801 group in material and environment and are partially consistent with respect to aging effects and credited aging management program, as clarified below.</p>

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16 (cont.)		biofouling			<p>Consistent with NUREG-1801, this group includes brass (not aluminum brass), copper, carbon steel and stainless steel at VCSNS. Brass and copper components/component types are also addressed later in this table for selective leaching of open and/or closed cycle cooling system components.</p> <p>Consistent with NUREG-1801, this group includes various components/component types in systems, or components serviced by, an open-cycle cooling water system, the Service Water System at VCSNS.</p> <p>Consistent with NUREG-1801, copper, brass and stainless steel components/component types within this group at VCSNS are not susceptible to a loss of material due to general corrosion and no management of that effect is</p>

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
16 (cont.)					<p>required for those components/component types.</p> <p>In addition to the aging effects specified in NUREG-1801, for this group, the credited aging management program at VCSNS also manages particulate fouling and loss of material due to erosion of susceptible components/component types. Furthermore, biofouling as is referenced in NUREG-1801, has been labeled as fouling due to biological materials at VCSNS. NUREG-1801 specifies an Open-Cycle Cooling Water System program. The VCSNS component/component type AMR results, for this group, credit the corresponding Service Water System Reliability and Inservice Testing program (<b>Appendix B.1.9</b>) to manage the specified aging effects during the period of extended operation.</p>

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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	<p>The component/component type AMR results, in this group, for VCSNS are consistent with NUREG-1801 in material, environment, aging effects (mechanisms) requiring management and credited aging management program, as clarified below.</p> <p>Consistent with NUREG-1801, the component/component type AMR results for VCSNS include carbon steel materials that are underground and wrapped/coated. In addition to the NUREG-1801 materials, this group includes cast iron and ductile iron (cement-lined internally) at VCSNS.</p> <p>In addition to the piping and fittings components/component types, this group includes tanks, and hydrants (including internal valve) at VCSNS. Also, in addition to the</p>

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
17 (cont.)					<p>NUREG-1801 aging effects (mechanisms) requiring management for this group, certain components/component types in this group at VCSNS are also susceptible to a loss of material due to galvanic corrosion.</p> <p>Consistent with NUREG-1801 options for this group, the Buried Piping and Tanks Inspection (<b>Appendix B.2.10</b>) activity is credited with the management of aging for susceptible components/component types.</p>
18	Components in compressed air system	Loss of material due to general and pitting corrosion	Compressed air monitoring	No	<p>No components/component types, that are subject to AMR, in compressed air systems at VCSNS were matched to NUREG-1801 items for this group since, by design, the compressed air systems at VCSNS are dry and oil-free. As such, a Compressed Air Monitoring program is not credited for aging management at VCSNS.</p>

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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	<p>The VCSNS Aging Management Programs for this group are generally consistent with those reviewed and approved in NUREG-1801. The VCSNS Fire Protection Program (<b>Appendix B.1.5</b>) contains many activities to achieve defense-in-depth and minimize the impact of a potential fire.</p> <p>The Fire Barrier and Fire Barrier Seal Inspections detect structural damage or degradation of fire barriers and fire barrier penetration sealing devices. Fire barriers include walls, ceilings and floors. The corresponding aging effects are cracking, separation from walls or components, separation of material layers, rupture or puncture of seals, shrinkage and voids.</p> <p>The Fire Door Inspections detect structural</p>

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19 (cont.)					<p>damage or degradation of fire rated doors. Inspections are credited with managing loss of material of doors and door hardware for the period of extended operation. Excessive wear for door appurtenances such as latches, strike plates, hinges, sills and closing devices, and maintaining proper clearances (gaps) between the door, frame and threshold are also inspected, but these attributes are not credited for license renewal. Loss of material due to wear of the door hardware and hinges is not considered an aging effect but rather a consequence of frequent or rough usage.</p>
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	<p>The component/component type AMR results in this group for VCSNS are consistent with NUREG-1801 in material and environment, and are partially consistent in aging effects (mechanisms) and credited aging management program, as clarified below.</p>

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20 (cont.)					<p>Consistent with NUREG-1801, the component/component type AMR results for VCSNS include carbon steel, cast iron, bronze, and stainless steel. In addition to the NUREG-1801 materials, this group includes black steel, galvanized steel (conservatively considered similar to carbon/low alloy steel) and brass at VCSNS.</p> <p>Consistent with NUREG-1801, the aging effects (mechanisms) requiring management for this group includes loss of material due to general corrosion (carbon steel and cast iron only), crevice and/or pitting corrosion, galvanic corrosion, and microbologically influenced corrosion (MIC).</p> <p>Biofouling, as it is named in NUREG-1801 for</p>

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
20 (cont.)					<p>this group, is referred to as "fouling due to biological materials" at VCSNS. In addition to the NUREG-1801 aging effects/mechanisms for this group, "fouling due to particulates" is managed by the credited aging management program at VCSNS.</p> <p>While not specified in NUREG-1801 for Fire Protection components in particular, certain components/component types in this group at VCSNS were also determined to be susceptible to a loss of material due to selective leaching based on their materials of construction (cast iron or brass) and environment. This aging effect/mechanism is also managed by the credited aging management program at VCSNS.</p> <p>The mechanical portion of the existing Fire</p>

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20 (cont.)					Protection Program ( <b>Appendix B.1.5</b> ) at VCSNS, referred to in this application as "Fire Protection Program - Mechanical", is credited for management of pertinent aging effects.
21	Components in diesel fire system	Loss of material due to galvanic, general, pitting, and crevice corrosion	Fire protection and fuel oil chemistry	No	Component/component type AMR results for the diesel fuel oil portion of the Fire Service system (that is tank and fuel supply line to the diesel driven fire pump) is included with the other diesel fuel oil supply portions in a separate portion of this table based on material, environment, aging effects (mechanisms) requiring management and credited aging management program similarities. As such, the NUREG-1801 items within this group are not considered applicable to VCSNS. Furthermore, the inclusion of fire service fuel oil supply with other fuel oil supply portions is conservative with respect to aging effects requiring management.

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
21 (cont.)					<p>The pump casing of the diesel fire pump at VCSNS is not exposed to the fuel oil provided to the diesel engine, but to the fire service water. As such, the component/component type AMR results for VCSNS that include the casing of the diesel driven fire pump are included in the appropriate portion of this table.</p>
22	Tanks in diesel fuel oil system	Loss or material due to general, pitting, and crevice corrosion	Above ground carbon steel tanks	No	<p>The component AMR results for the external surface of the Fire Service system Diesel Fuel Oil Tank are consistent with this NUREG-1801 group with respect to material and environment and partially with respect to aging effect requiring management, as clarified below. However, an management program that includes a thickness measurement of the tank bottom surface is not required and an activity corresponding to the NUREG-1801 "Above</p>

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22 (cont.)					<p>Ground Tank Inspection" is not credited.</p> <p>Due to environment differences (i.e. location underground or indoors), the component AMR results for other subject diesel fuel tanks are included in the appropriate portion of this table. Likewise, the internal surfaces of all these tanks are included in the appropriate portion of this table.</p> <p>Consistent with NUREG-1801, the carbon steel Fire Service system Diesel Fuel Oil Tank is susceptible to loss of material due to general corrosion. In addition to the NUREG-1801 aging effects requiring management, the Fire Service system Diesel Fuel Oil Tank is susceptible to a loss of material due to galvanic corrosion from a connection to a more cathodic material. However, the ambient</p>

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
22 (cont.)					external conditions at VCSNS do not contain sufficient contaminants that could concentrate at wetted locations to cause localized crevice or pitting corrosion. Additionally, the VCSNS Fire Service system Diesel Fuel Oil Tank is mounted on stilts making all external surfaces accessible for inspection and the plant-specific Inspections for Mechanical Components ( <b>Appendix B.2.11</b> ) is credited with management of the specified aging effects.
23	Closure bolting	Loss of material due to general corrosion; crack initiation and growth due to cyclic loading and SCC	Bolting integrity	No	Non-Class 1 Closure bolting is considered to be a piece-part of the components/component types as a whole at VCSNS. Therefore a bolting integrity program is not credited for aging management. As a piece-part of subject components/component types at VCSNS, the specific bolting/fastener materials were not itemized as a separate Non-Class 1 component or component type. Additionally, for

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23 (cont.)					carbon and alloy steel components, the aging management program credited for managing external general corrosion of the applicable components/component types (e.g. Inspections for Mechanical Components [Appendix B.2.11]) will also inherently address their fasteners, thus requiring no separate action.
24	Components (aluminum bronze, brass, cast iron, cast steel) in open-cycle and closed-cycle cooling water systems, and ultimate heat	Loss of material due to selective leaching	Selective leaching of materials	No	<p>No component/component type AMR results at VCSNS are consistent with a NUREG-1801 item within this group. As such, a selective leaching of materials inspection activity is not credited for aging management.</p> <p>The component/component type AMR results for components in or directly serviced by the Service Water system (open-cycle cooling/ultimate heat sink), addressed previously in this table, indicate that selective leaching is not an aging effect to which they are susceptible due</p>

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
24 (cont.)	sink				<p>to the actual material of construction (e.g. no-alloying copper, inhibiting elements, etc.). Furthermore, although a NUREG-1801 item in this group indicates that cast steel pump casings in closed-cycle cooling systems are susceptible to selective leaching, available technical documentation and operating experience, as well as corresponding NUREG-1801 aging management program description, supports that cast steel actually refers to cast iron.</p> <p>VCSNS component/component type AMR results which were determined to have a susceptibility to selective leaching are addressed elsewhere in this table (brass, copper and cast iron Fire Service components/component types) and in <b>Table 3.3-2 Item 28</b> of this application section (closed-cycle cooling components).</p>

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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	<p>The VCSNS Aging Management Programs for this group are generally consistent with those reviewed and approved in NUREG-1801. The VCSNS Fire Protection Program (<b>Appendix B.1.5</b>) contains many activities to achieve defense-in-depth and minimize the impact of a potential fire.</p> <p>The Fire Barrier Inspections detect structural damage or degradation of fire barriers. Fire barriers include walls, ceilings and floors. The corresponding aging effects are cracking (excluding hairline cracks), spalling and loss of material.</p> <p>The Maintenance Rule Structures Program (<b>Appendix B.1.18</b>) is responsible for managing the attributes associated with the aging of structures and structural components,</p>

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<b>AMR Item</b>	<b>Component Group</b>	<b>Aging Effect / Mechanism</b>	<b>Aging Management Program</b>	<b>Further Evaluation Recommended</b>	<b>Discussion</b>
25 (cont.)					<p>including those in this grouping. These aging effects include loss of material due to corrosion, cracking and change in material properties, and are detected by visual inspection of external surfaces.</p> <p><b>Section 3.5</b> of the Application provides the primary discussions concerning structural monitoring.</p>

### **3.3.3.3 Aging Management Evaluations That Are Different From Or Not Addressed In NUREG-1801**

Aging Management Evaluations that are different from or not addressed in NUREG-1801 are identified and discussed in Table 3.3-2. The standard six-column format has been utilized. The discussion column provides additional details regarding the aging management conclusions reached by VCSNS for the component type.

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**THAT ARE DIFFERENT FROM OR NOT ADDRESSED IN NUREG-1801 BUT ARE RELIED ON FOR LICENSE RENEWAL**

AMR Item	Component Type	Material	Environment	Aging Effect / Mechanism	Program/Activity	Discussion
1	Piping, tubing, valves (body/bonnet only), heat exchangers and associated components	Stainless Steel	Air-Gas (moist air)	None Identified	None Required	This grouping includes the external surface of stainless steel subject components/component types that are exposed to ambient conditions. These ambient conditions include the heat, cold, humidity and various forms of precipitation outdoors as well as the lesser heat, cold and humidity indoors (inside the Reactor Building and other in-scope plant buildings). Additionally, this grouping includes the internal surfaces of subject components/component types that are either open to the ambient conditions in the building/room in

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AMR Item	Component Type	Material	Environment	Aging Effect / Mechanism	Program/Activity	Discussion
1 (cont.)						<p>which they are located or have been closed off from the process stream at ambient conditions.</p> <p>However, the ambient conditions in the indoor or outdoor environments at VCSNS do not contain contaminants in sufficient quantities to concentrate in wetted locations and cause corrosion/degradation of stainless steel.</p>
2	Ductwork and HVAC pressure boundary components (including	Stainless Steel	Air-Gas (moist air)	None Identified	None Required	This grouping includes the internal and external surfaces of stainless steel ventilation system (Air Handling and Local Ventilation & Cooling)

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AMR Item	Component Type	Material	Environment	Aging Effect / Mechanism	Program/Activity	Discussion
2 (cont.)	housings, pipe, tubing and valves (body/bonnet only)					components/component types that are exposed to moist air (both ambient externally and conditioned internally). Stainless steel is not susceptible to corrosion/degradation in the absence of sufficient contaminant quantities, which are not found in the ambient building environments or outside environments at VCSNS.
3	Ductwork and HVAC pressure boundary components (including housings,	Galvanized Steel, Carbon Steel	Air-Gas (moist air)	None Identified	None Required	This grouping includes the internal surface of carbon and galvanized steel ventilation system (Air Handling and Local Ventilation & Cooling) components/component types that are

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<b>AMR Item</b>	<b>Component Type</b>	<b>Material</b>	<b>Environment</b>	<b>Aging Effect / Mechanism</b>	<b>Program/Activity</b>	<b>Discussion</b>
3 (cont.)	valves (body/ bonnet only)					<p>exposed to moist air as well as the external surface of the exhaust air relief heads that are exposed to the heat, cold, humidity, and various forms of precipitation outdoors. Otherwise, the external surfaces of subject components/component types in this grouping are addressed in <b>Table 3.3-1 Item 5</b>.</p> <p>While the AMR results for subject components/component types in this grouping at VCSNS are consistent with NUREG-1801 with respect to material and environment, no</p>

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AMR Item	Component Type	Material	Environment	Aging Effect / Mechanism	Program/Activity	Discussion
3 (cont.)						<p>aging effects were determined to require management at VCSNS. This determination was made due to the lack of sufficient contaminants in the moist air environment to promote crevice, pitting, or microbologically influenced corrosion in wetted locations, the resistance of galvanized steel to general corrosion in (non-wetted) air, and to the subject carbon steel components/component types being considered thick-walled such that any moisture related general corrosion will not result in loss of function during the period of extended operation.</p>

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AMR Item	Component Type	Material	Environment	Aging Effect / Mechanism	Program/Activity	Discussion
4	Components/ component types in com- pressed gas service (CO <sub>2</sub> fire service extinguishing and HVAC Chillers refrigerant addition/ purge)	Black Steel, Brass, Bronze, Carbon Steel, Cast Iron, Cop- per, Stainless Steel	Air-Gas (dry)	None Identified	None Required	The material/environment combination for this group- ing is not addressed for any item in GALL Chapters IV, V, VII or VIII. Also, no aging effects were determined to require management during the period of extended operation. This grouping includes the internal sur- faces of subject compo- nents/component types in the Fire Service System (carbon dioxide extinguish- ing portion) and Chilled Water System (refrigerant addition and purge portion). At VCSNS, the process environment inside these portions is by design a dry

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AMR Item	Component Type	Material	Environment	Aging Effect / Mechanism	Program/Activity	Discussion
4 (cont.)						gas, free of moisture or contaminants, which could cause corrosion/degradation.
5	Pumps, piping, valves (body/bonnet only), and associated lubrication components (not including RCP Oil Collection)	Brass, Carbon Steel, Cast Iron, Copper, Copper-Nickel, Ductile Iron, Stainless Steel	Oil	None Identified	None Required	This grouping includes oil-coated surfaces of subject components/component types exposed to lubricating oil that are not subject to wetting.
6	Pumps, Pipe, Tube, Fittings, Valves (Body/Bonnet only) and	Stainless Steel	Treated Water (specifically chemically treated borated water)	Loss of Material due to Crevice Corrosion, Pitting Corrosion; Cracking due to Stress	Chemistry Program	This grouping includes subject component/component types in systems (Boron Recycle, Nuclear Sampling, Radiation Monitoring, Spent

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AMR Item	Component Type	Material	Environment	Aging Effect / Mechanism	Program/Activity	Discussion
6 (cont.)	associated components			Corrosion Cracking (SCC)		<p>Fuel Cooling, Thermal Regeneration) whose process environment is boric acid water and that are either not closed-cycle cooling water systems as described in NUREG-1801, or if directly serviced by a closed-cycle cooling water system are the surface exposed to the medium being cooled.</p> <p>This grouping is consistent with NUREG-1801 Engineered Safety Feature items with respect to material, environment, aging effect requiring management, and credited program</p>

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<b>AMR Item</b>	<b>Component Type</b>	<b>Material</b>	<b>Environment</b>	<b>Aging Effect / Mechanism</b>	<b>Program/Activity</b>	<b>Discussion</b>
6 (cont.)						<p>(with the conservative addition of loss of material due to crevice and pitting corrosion).</p> <p>Only subject components/ component types in this grouping with process fluid temperatures above 140°F are susceptible to cracking due to SCC. As in NUREG-1801 for Engineered Safety Feature items, the Chemistry Program (<b>Appendix B.1.4</b>) is credited to manage the conditions that could result in the specified aging effects/mechanisms during the period of extended operation.</p>

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AMR Item	Component Type	Material	Environment	Aging Effect / Mechanism	Program/Activity	Discussion
7	Nuclear Sampling system sample cooling tubes	Nickel-Based Alloy (Alloy 600)	Treated Water (including Borated Water, secondary side blowdown, Component Cooling Water)	Loss of Material due to Crevice Corrosion, Pitting Corrosion; Cracking due to Stress Corrosion Cracking (SCC); and Heat Exchanger Fouling due to Particulates (Component Cooling water only)	Chemistry Program	The components in this grouping at VCSNS are consistent with a NUREG-1801 Reactor Coolant item (Table 3.1-1 Item 15) with respect to material and environment and partially for aging effect requiring management. However, this material is not addressed in NUREG-1801, except for Reactor Coolant, and VCSNS evaluations have determined that the tubes in this grouping are not susceptible to primary water stress corrosion cracking (PWSCC) that is normally considered in a high temperature

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AMR Item	Component Type	Material	Environment	Aging Effect / Mechanism	Program/Activity	Discussion
7 (cont.)						<p>borated water environment.</p> <p>The existing Chemistry Program (<b>Appendix B.1.4</b>) is credited for managing the conditions that could result in the specified aging mechanisms during the period of extended operation and provides reasonable assurance that the component intended functions will be maintained for all CLB conditions.</p>
8	Pipe and Fittings	Stainless Steel, Carbon Steel	Embedded in Concrete	None Identified	None Required	<p>This grouping includes the external surface of subject components/component types (Spent Fuel Cooling, Nuclear Plant Drains, and Service Water systems)</p>

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AMR Item	Component Type	Material	Environment	Aging Effect / Mechanism	Program/Activity	Discussion
8 (cont.)						that are embedded in concrete. The concrete forms a tight seal that prevents exposure of the subject piping to aggressive chemical species that could cause corrosion.
9	Ductwork, Piping, Fittings and/or Tubing which enters or passes between buildings below the 425' Elevation	Stainless Steel	Air-Gas (moist air)	Loss of Material Microbiologically Influenced Corrosion (MIC) {External Surface}	Maintenance Rule Structures Program	At VCSNS, piping or tubing component types which enter buildings or pass between buildings that do not share a common wall below the 425' elevation are conservatively susceptible to the accumulation of external sulfate-reducing-bacteria resulting from groundwater intrusion. With the exception of those components types which pass

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AMR Item	Component Type	Material	Environment	Aging Effect / Mechanism	Program/Activity	Discussion
9 (cont.)						<p>through a "fire seal" penetration, that are not susceptible to groundwater intrusion, these components may see a build-up of sulfate reducing bacteria at the wall/component interface and thereby be susceptible to localized external MIC. The Maintenance Rule Structures Program (<b>Appendix B.1.18</b>) will manage a loss of material due to external MIC for susceptible locations during the period of extended operation.</p>
10	Piping, muffler, expansion joints in	Carbon Steel, Stainless Steel	Air-Gas (primarily moist air plus periodic	None Identified	None Required	This grouping includes the exhaust piping, mufflers and expansion joints

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AMR Item	Component Type	Material	Environment	Aging Effect / Mechanism	Program/Activity	Discussion
10 (cont.)	Diesel engine exhausts (Fire Service (FS) and Diesel Generator Services (DG) systems)		exhaust gases)			<p>associated with the Diesel Driven Fire Service Pump and Emergency Diesel Generators. While this grouping is consistent with a NUREG-1801 item with respect to material and environment. However, due to these thick-walled components not being continuously exposed to hot exhaust gases, any general corrosion would be insufficient to cause loss of component intended function during the period of extended operation.</p> <p>Thin-walled carbon steel portions of these exhaust</p>

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AMR Item	Component Type	Material	Environment	Aging Effect / Mechanism	Program/Activity	Discussion
10 (cont.)						trains are addressed in <b>Table 3.3-1 Item 5.</b>
11	Piping, tubing, valves (body/bonnet only) and associated components	Carbon Steel, Stainless Steel	Air-Gas	None Identified	None Required	This grouping includes various materials in the intake/starting air (Diesel Generator Services System), control air (Service Air System), and gaseous waste/effluent (Liquid and Gaseous Waste Processing Systems) that are normally exposed to an air or gas environment where moisture is not controlled through design. However, at VCSNS, these components/component types are stainless steel and not susceptible to strictly moisture related degradation or are

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AMR Item	Component Type	Material	Environment	Aging Effect / Mechanism	Program/Activity	Discussion
11 (cont.)						thick-walled carbon steel and not prone to a loss of function from strictly moisture related degradation since a protective coating is formed, slowing the corrosion rate, and the allowable minimum wall thickness would not be exceeded during the period of extended operation.
12	Piping, tubing, valves (body/bonnet only) and associated components	Aluminum, Brass, Copper	Air-Gas	None Identified	None Required	This grouping includes various materials in the intake/starting air of the Diesel Generator Services System that are normally exposed to a moist air environment. However, moisture alone is insufficient to cause the degradation of

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AMR Item	Component Type	Material	Environment	Aging Effect / Mechanism	Program/Activity	Discussion
12 (cont.)						the materials within this grouping. Furthermore, the components/component types are in locations that are not susceptible to the wetting required for degradation.
13	Instrument Air system piping, tubing and valves	Aluminum, Brass, Carbon Steel, Cast Iron, Stainless Steel	Air-Gas	None Identified	None Required	This grouping includes various materials in the Instrument Air System (IA) that are normally exposed to compressed air that is, by design, dry, oil-free, and filtered. As such, no aging effects require management for the subject components/component types in this grouping during the period of extended operation since the design

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AMR Item	Component Type	Material	Environment	Aging Effect / Mechanism	Program/Activity	Discussion
13 (cont.)						precludes moisture collection in these components/ component types. The AMR results for component types in this system, as well as other compressed control air systems where moisture related aging is a concern during the period of extended operation are addressed separately below.
14	Piping, Tubing and Valves (body/ bonnet only)	Carbon Steel	Air-Gas (compressed air w/ moisture)	Loss of Material due to General Corrosion or Galvanic Corrosion (components in contact with more cathodic material)	Service Air System Inspection	This grouping includes subject component types in compressed air systems (Service Air, Instrument Air, Building Services Systems) where moisture is not controlled through system design. The Service Air

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AMR Item	Component Type	Material	Environment	Aging Effect / Mechanism	Program/Activity	Discussion
14 (cont.)						System Inspection ( <b>Appendix B.2.6</b> ) will manage loss of material due to general corrosion (oxygen and moisture) or galvanic corrosion for component types in this grouping. This program is a one-time inspection and will provide reasonable assurance during the period of extended operation that the component intended function(s) will be maintained under all CLB conditions
15	Gaseous Waste Processing system helical coils,	Stainless Steel	Air-Gas, Treated Water	Loss of Material due to Crevice and Pitting Corrosion; Cracking due to Stress	Waste Gas System Inspections	While somewhat consistent with NUREG-1801 with respect to material, environment and aging effect(s) requiring management, this