Table 3.3-2:
SUMMARY OF AGING MANAGEMENT EVALUATIONS FOR THE AUXILIARY SYSTEMS
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
15	manifolds, pipe and valves (body/ bonnet only)			Corrosion Cracking (SCC)		grouping includes components/component types that are subject to collection of water (moisture) in an environment that is not controlled by the Chemistry Program (**Appendix B.1.4**). As such the one-time Waste Gas System Inspection (**Appendix B.2.8**) is credited for the management of the identified aging effects during the period of extended operation.
16	Fire Service system piping	Cement-lined ductile iron	Raw Water	None Identified	None Required	This grouping includes Fire Service Main Header piping that is exposed to raw water and is normally stagnant awaiting system actuation. While cement is

Table 3.3-2:
SUMMARY OF AGING MANAGEMENT EVALUATIONS FOR THE AUXILIARY SYSTEMS
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
16 (cont.)						addressed for Civil/Structural components in NUREG-1801, the use of cement lined pipe in the Fire Service System precludes the degradation of that piping as the cement provides a protective layer for the piping and is not susceptible to the extreme conditions (temperature, aggressive chemicals, etc.) which may cause degradation of cement.
17	Pumps, Piping, Tubing, Fittings, Valves (body/bonnet only)	Stainless Steel	Treated Water (including makeup water, secondary side blowdown, cooling water)	Loss of Material due to Crevice and Pitting Corrosion; Cracking due to Stress Corrosion	Chemistry Program	This grouping includes subject components/component types of auxiliary systems that are not closed cycle cooling systems (Nuclear Sampling, Reactor

Table 3.3-2:
SUMMARY OF AGING MANAGEMENT EVALUATIONS FOR THE AUXILIARY SYSTEMS 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
17 (cont.)				Cracking (SCC)		Makeup Water) but whose process fluid is treated water. This grouping is consistent with NUREG-1801 Engineered Safety Features items with respect to material, environment, aging effect requiring management and credited program, with the conservative addition of crevice and pitting corrosion. As in NUREG-1801 for the associated Engineered Safety Features items, the Chemistry Program (**Appendix B.1.4**) manages the conditions that could lead to the specified aging effects/ mechanisms during the

Table 3.3-2:
SUMMARY OF AGING MANAGEMENT EVALUATIONS FOR THE AUXILIARY SYSTEMS
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
17 (cont.)						period of extended operation.
18	Fire Service system nozzles, piping and fire hydrants	Galvanized Steel, Carbon Steel, Cast Iron	Air-Gas (air)	None Identified	None Required	This grouping includes fire service system portions (those not constructed of stainless steel) that are normally in a drained down condition awaiting system actuation and therefore normally exposed to ambient conditions rather than raw water. While the air is not strictly dry, the moisture content is expected to be very low. Additionally, the components are thick-walled such that the minimal resulting corrosion, if

Table 3.3-2:
SUMMARY OF AGING MANAGEMENT EVALUATIONS FOR THE AUXILIARY SYSTEMS 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
18 (cont.)						any, would result in loss of component function during the period of extended operation.
19	Tanks (including Component Cooling Water Surge Tank, Chilled Water Expansion Tanks)	Carbon Steel	Air-Gas (moist air), Treated Water	Loss of Material due to Crevice, Pitting, General, Galvanic Corrosion and due to the 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 Closed Cycle Cooling Water item with respect to material, environment, and aging effect requiring management. However, additional aging effects require management at VCSNS for this Auxiliary grouping. NUREG-1801 does not address the corrosive impacts of alternate wetting and drying of vented tanks (or tanks without a

Table 3.3-2:
SUMMARY OF AGING MANAGEMENT EVALUATIONS FOR THE AUXILIARY SYSTEMS
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
19 (cont.)						cover gas) that could concentrate contaminants above bulk fluid concentrations and result in further degradation. The Chemistry Program (**Appendix B.1.4**) will manage the conditions required for a loss of material of the components in this grouping to occur in bulk fluid (treated water) concentrations. In addition, the one-time Above Ground Tank Inspection (**Appendix B.2.1**) will manage a loss of material due to the corrosive impacts of alternate wetting and drying as well

Table 3.3-2:
SUMMARY OF AGING MANAGEMENT EVALUATIONS FOR THE AUXILIARY SYSTEMS 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
19 (cont.)						as general or galvanic corrosion in the tank and attached components above the normal water level.
20	Tanks (including Reactor Makeup Water Storage Tank, Nuclear Sampling Flush Water Storage Tank)	Stainless Steel	Air-Gas (moist air), Treated Water	Loss of Material due to Crevice or Pitting Corrosion; Cracking due to Stress Corrosion Cracking (SCC); 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 **[Appendix B.1.4]**). However, additional aging effects require management at VCSNS for this Auxiliary grouping. NUREG-1801 does not

Table 3.3-2:
SUMMARY OF AGING MANAGEMENT EVALUATIONS FOR THE AUXILIARY SYSTEMS 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
20 (cont.)						address the corrosive impacts of alternate wetting and drying of vented tanks (or tanks without a cover gas) that could concentrate contaminants above bulk fluid concentrations and result in further degradation. The Chemistry Program (**Appendix B.1.4**) 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

Table 3.3-2:
SUMMARY OF AGING MANAGEMENT EVALUATIONS FOR THE AUXILIARY SYSTEMS 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
20 (cont.)						(**Appendix B.2.1**) will manage the corrosive impacts of alternate wetting and drying to occur in stainless steel in the treated water environment.
21	Piping, Valves (body/ bonnet only), Heat Exchanger tubes	Stainless Steel	Liquid Waste/ Drain Water (including borated, treated water)	Loss of Material due to Crevice and Pitting Corrosion and/or Cracking due to Stress Corrosion Cracking (SCC)	Liquid Waste System Inspection	This grouping includes subject component types in systems (Liquid Waste Processing, Nuclear Plant Drains) that contain/transport liquid waste or drain water that has the potential for contamination. This grouping is consistent with a NUREG-1801 Engineered Safety Feature item with respect to material, environment, and aging effect requiring

Table 3.3-2:
SUMMARY OF AGING MANAGEMENT EVALUATIONS FOR THE AUXILIARY SYSTEMS THAT ARE DIFFERENT FROM OR NOT ADDRESSED IN NUREG-1801 BUT ARE RELIED ON FOR LICENSE RENEWAL

Item	Component Type	Material	Environment	Aging Effect / Mechanism	Program/Activity	Discussion
21 (cont.)						management with the addition of loss of material due to crevice and pitting corrosion. However, the one-time Liquid Waste System Inspection (**Appendix B.2.3**) will provide reasonable assurance that the component intended function(s) will be maintained under CLB conditions during the period of extended operation.
22	Drain Pan and Drain Piping	Stainless Steel	Treated Water (condensate quality water with traces of boric acid)	Loss of Material due to Crevice and Pitting Corrosion	Reactor Building Cooling Unit Inspection	This grouping includes the loop seal drain lines on the Reactor Building Cooling Units (RBCUs), Roof Drain System, and is consistent with an Engineered Safety Feature NUREG-1801 item

Table 3.3-2:
SUMMARY OF AGING MANAGEMENT EVALUATIONS FOR THE AUXILIARY SYSTEMS
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
22 (cont.)						with respect to material and environment. However, due to temperatures well below 140°F, the drain lines are not susceptible to cracking due to SCC but are susceptible to a loss of material due to crevice or pitting corrosion. The one-time Reactor Building Cooling Units Inspection (**Appendix B.2.5**) will provide reasonable assurance that the component function of these drains will be maintained during the period of extended operation.
23	Sight glass (body only)	Glass	Air-Gas (including moist air, starting air), Oil	None Identified	None Required	This grouping includes the external and internal surfaces of sight glasses and

Table 3.3-2:
SUMMARY OF AGING MANAGEMENT EVALUATIONS FOR THE AUXILIARY SYSTEMS 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
23 (cont.)						glass portions of pressure retaining instruments that is inert and not susceptible to age related degradation.
24	Motor Bearing Cooler Fins	Aluminum	Air-Gas (moist air)	Heat Exchanger Fouling due to Particulates	Preventive Maintenance Activities – Ventilation Systems Inspection	This grouping includes the fins of the fin/tube type Component Cooling Water Pump motor integral coolers. Particulate fouling of the air side can occur from the accumulation and build-up of dust, dirt or debris on and between the fins of air coolers. The Preventive Maintenance Activities - Ventilation Systems Inspections (**Appendix B.1.26**) will manage heat exchanger fouling due to particulates for these

Table 3.3-2:
SUMMARY OF AGING MANAGEMENT EVALUATIONS FOR THE AUXILIARY SYSTEMS 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
24 (cont.)						aluminum components during the period of extended operation, as well as for the other portions of the coolers, as included in **Table 3.3.1 Item 14**.
25	Valves (body/ bonnet only) and piping components	Aluminum, Brass, Copper	Air-Gas (moist air)	None Identified	None Required	This grouping includes the external surface of subject components/component types that are in locations (such as the Diesel Generator Building) where exposure to leaking borated water is not a possibility and the ambient conditions in those locations do not contain contaminants in sufficient quantities to result in other forms of corrosion to the materials in this

Table 3.3-2:
SUMMARY OF AGING MANAGEMENT EVALUATIONS FOR THE AUXILIARY SYSTEMS
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
25 (cont.)						grouping.
26	Flexible Hose and Coupling	Rubber	Oil/Fuel Oil, Treated Water	None Identified	None Required	This grouping includes the internal surface of rubber components/component types (Diesel Generator Services System) that are not considered to be susceptible to degradation in fluid environments due to the lack of excessive temperatures and to the change in material properties of elastomers being more closely tied to external conditions such as ultraviolet radiation. The external surfaces of these components are addressed as applicable in

Table 3.3-2:
SUMMARY OF AGING MANAGEMENT EVALUATIONS FOR THE AUXILIARY SYSTEMS
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
26 (cont.)						**Table 3.3.1 Item 2.**
27	Piping, tubing and fittings	Brass, Copper	Fuel Oil	Loss of Material due to Microbiologically Influenced Corrosion (MIC)	Chemistry Program	This grouping includes subject components/component types exposed to fuel oil in locations that are not susceptible to water pooling (Diesel Generator Services System). Although the components/component types in this grouping are not susceptible to water pooling, and thereby to related degradation mechanisms, the Chemistry Program (**Appendix B.1.4**) is conservatively credited for the management of the conditions that could lead to MIC in the fuel oil environment.

Table 3.3-2:
SUMMARY OF AGING MANAGEMENT EVALUATIONS FOR THE AUXILIARY SYSTEMS
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
28	Cooling unit tubes and fittings	Brass, Copper, Copper Nickel	Treated Water	Loss of Material due to crevice, pitting and/or galvanic corrosion, as well as erosion-corrosion, and selective leaching; Heat exchanger fouling due to particulates; Cracking due to stress corrosion cracking (SCC)	Chemistry Program & Heat Exchanger Inspections	This grouping includes subject cooling components/ component types with a treated water process fluid on one side and a non water process fluid on the other (Air Handling, Local Ventilation and Cooling, Chilled Water, Component Cooling, Diesel Generator Services Systems). Also included are brass components exposed to closed cycle cooling water that are susceptible to selective leaching due to their material compositions. The material, environment, aging effect requiring management for this grouping

Table 3.3-2:
SUMMARY OF AGING MANAGEMENT EVALUATIONS FOR THE AUXILIARY SYSTEMS
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
28 (cont.)						are consistent with a NUREG-1801 item for heat exchangers between open-cycle systems and closed-cycle systems, except that the surface not exposed to treated (closed-cycle) water is not an open-cycle system, as described in NUREG-1801, and therefore not within the scope of the corresponding aging management program. At VCSNS, the Chemistry Program (**Appendix B.1.4**) is considered to provide adequate management of the conditions which could result in crevice, pitting or

Table 3.3-2:
SUMMARY OF AGING MANAGEMENT EVALUATIONS FOR THE AUXILIARY SYSTEMS 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
28 (cont.)						galvanic corrosion during the period of extended operation. In addition to the Chemistry Program (**Appendix B.1.4**), the one-time Heat Exchanger Inspection (**Appendix B.2.12**) is credited for the characterization of a loss of material due to erosion-corrosion, heat exchanger fouling due to particulates (components in systems taking suction from the bottom of a tank), if any, and loss of material due to selective leaching.

3.3.4 REFERENCES

3.3-1	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.
3.3-2	NUREG-1801, "Generic Aging Lessons Learned Report," Volumes 1 and 2, NRC, April 2001.
3.3-3	NUREG-1800, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants," NRC, April 2001.

3.4 AGING MANAGEMENT OF STEAM AND POWER CONVERSION SYSTEMS

3.4.1 SYSTEM DESCRIPTION

The Steam and Power Conversion Systems act as a heat sink to remove heat from the nuclear steam supply system and convert the heat generated in the reactor to the plant's electrical output.

The Steam and Power Conversion Systems include the following systems:

- Auxiliary Boiler Steam and Feedwater System
- Condensate System
- Emergency Feedwater System
- Extraction Steam System
- Feedwater System
- Gland Seal Steam System
- Main Steam System
- Main Steam Dump System
- Steam Generator Blowdown System

3.4.2 AGING MANAGEMENT REVIEW

3.4.2.1 Methodology

Aging management review of Steam and Power Conversion 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 3.4-1**]. 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 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 3.4-2**] and evaluated for consistency with NUREG-1801 programs that are relied on for license renewal. The results are documented and discussed in Table 3.4-1 using the format suggested by the NRC Standard Review Plan for License Renewal (NUREG-1800) [**Reference 3.4-3**].

3.4.2.2 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.

3.4.3 AGING MANAGEMENT PROGRAM

3.4.3.1 Aging Management Programs Evaluated In NUREG-1801 That Are Relied On For License Renewal

Table 3.4-1 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 Steam and Power Conversion Systems. The table is based on Table 3.4-1 of NUREG-1800 **[Reference 3.4-3]** 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.

3.4.3.2 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 3.4-1. A cross-reference is provided to the section of the application where TLAAs are discussed.

Table 3.4-1:

SUMMARY OF AGING MANAGEMENT PROGRAMS FOR THE STEAM & POWER CONVERSION SYSTEMS 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 and fittings in main feedwater line, steam line and auxiliary feedwater (AFW) piping (PWR only)	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 at VCSNS. See **Section 4.3.2** for the TLAA discussion of Class 2 and 3 piping.
2	Piping and fittings, valve bodies and bonnets, pump casings, tanks, tubes, tubesheets, channel head, and	Loss of material due to general (carbon steel only), pitting, and crevice corrosion	Water chemistry and one-time inspection	Yes, detection of aging effects is to be further evaluated	The component /component type AMR results for VCSNS are consistent with NUREG-1801 in material, environment, aging effects, and partially consistent in program. The attributes of the credited program/activity are not fully consistent with the corresponding program attributes as described in NUREG-1801 because NUREG-1801 recommends augmentation of the Chemistry Program with a One Time Inspection. The Chemistry Program has

Table 3.4-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR THE STEAM & POWER CONVERSION SYSTEMS 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
2 (cont.)	shell (except main steam system)				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 (**Appendix B.1.4**) for treated water to manage aging effects when continued into the period of extended operation. A one-time inspection is, therefore, not warranted for the majority of components/component types in this group. The only exception is the Condensate Storage Tank which is inspected by the Above Ground Tank Inspections (**Appendix B.2.1**) activity. This activity also inspects the interior of the tank above the water line. Consistent with NUREG-1801, the aging mechanisms for this group include general corrosion, pitting corrosion, and crevice corrosion. In addition to these aging mechanisms, galvanic corrosion,

Table 3.4-1:

SUMMARY OF AGING MANAGEMENT PROGRAMS FOR THE STEAM & POWER CONVERSION SYSTEMS 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
2 (cont.)					stress corrosion cracking, and corrosive effects of alternate wetting and drying are managed at VCSNS. Consistent with NUREG-1801, this group includes stainless steel and carbon steel in treated water. In addition to these materials, this group includes low alloy steel and nickel-based metal at VCSNS. Consistent with NUREG-1801, this group includes piping and fittings, valve bodies, pump casings, and tanks of various systems within the steam and power conversion grouping. In addition, this group includes components/component types from the Nuclear Sampling System where these components/component types are similar and the above discussions apply.
3	AFW piping	Loss of material due to general,	Plant specific	Yes, plant specific	The combinations of components, materials, and environments identified in NUREG-1801

Table 3.4-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR THE STEAM & POWER CONVERSION SYSTEMS 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.)		pitting, and crevice corrosion, MIC, and biofouling			are not applicable to VCSNS. The AFW (Emergency Feedwater at VCSNS) piping at VCSNS is not exposed to untreated water. The Service Water System provides emergency backup to the Emergency Feedwater System through automatic isolation valves that normally provide boundary isolation between the treated water of the Emergency Feedwater System and the untreated water of the Service Water System. For a description of the aging effects of carbon steel in an untreated water environment refer to Aging Management of Auxiliary Systems in **Section 3.3**.
4	Oil coolers in AFW system (lubricating oil side possibly contaminated	Loss of material due to general (carbon steel only), pitting, and crevice corrosion,	Plant specific	Yes, plant specific	The component/component type AMR results for VCSNS are consistent with NUREG-1801 in material and environment. Water and contaminants will not intrude into the oil environments for these components/component

Table 3.4-1:

SUMMARY OF AGING MANAGEMENT PROGRAMS FOR THE STEAM & POWER CONVERSION SYSTEMS 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
4 (cont.)	with water)	and MIC			types. This 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 operations. Consistent with NUREG-1801, this group contains carbon steel and stainless steel in an oil environment. In addition to these materials, this group contains cast iron at VCSNS. Consistent with NUREG-1801, this group contains AFW (Emergency Feedwater System at VCSNS) bearing oil system components.
5	External surface of carbon steel components	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, and aging effect. However, NUREG-1801 recommends plant

Table 3.4-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR THE STEAM & POWER CONVERSION SYSTEMS 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
5 (cont.)					specific evaluation of the credited program. The credited program/activity at VCSNS is Inspections for Mechanical Components (**Appendix B.2.11**). Consistent with NUREG-1801 this program/activity will detect and manage loss of material due to general corrosion. In addition, this program will detect and manage loss of material due to galvanic corrosion. An additional program, Maintenance Rule Structures Program (**Appendix B.1.18**), will detect and manage loss of material due to microbiologically influenced corrosion (MIC) on external surfaces at susceptible locations (in contact with groundwater). Consistent with NUREG-1801, this group contains carbon steel in an ambient, moist air environment. In addition to carbon steel, this group contains low alloy steel and cast iron at

Table 3.4-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR THE STEAM & POWER CONVERSION SYSTEMS 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
5 (cont.)					VCSNS. Consistent with NUREG-1801, this group contains external surfaces for various components/component types.
6	Carbon steel piping and valve bodies	Wall thinning due to flow-accelerated corrosion	Flow-accelerated corrosion	No	The component/component type AMR results for VCSNS are consistent with NUREG-1801 in material, environment, aging effect, and program. Consistent with NUREG-1801, this group contains carbon steel in a treated water environment. In addition to carbon steel, this group contains low alloy steel at VCSNS. Consistent with NUREG-1801, this group includes valve bodies and piping and fittings of various systems within the steam and power conversion grouping. The Flow Accelerated Corrosion Monitoring Program (**Appendix B.1.6**) manages this aging effect/mechanism at VCSNS.

Table 3.4-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR THE STEAM & POWER CONVERSION SYSTEMS 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
7	Carbon steel piping and valve bodies in main steam system	Loss of material due to pitting and crevice corrosion	Water chemistry	No	The component/component type AMR results for VCSNS are consistent with NUREG-1801 in material, environment, aging effect, and credited program. Consistent with NUREG-1801, the aging mechanisms for this group are pitting corrosion and crevice corrosion. In addition to these mechanisms [illegible] corrosion and galvanic corrosion are managed at VCSNS. Consistent with NUREG-1801, this group contains carbon steel in a treated water environment. Consistent with NUREG-1801, this group contains valve bodies and piping and fittings. The Chemistry Program (**Appendix B.1.4**) manages this aging effect/mechanism at VCSNS.
8	Closure bolting in	Loss of material due to general	Bolting integrity	No	Non-Class 1 Closure bolting is considered to be a piece-part of the components/component

Table 3.4-1:

SUMMARY OF AGING MANAGEMENT PROGRAMS FOR THE STEAM & POWER CONVERSION SYSTEMS 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
8 (cont.)	high-pressure or high-temperature systems	corrosion; crack initiation and growth due to cyclic loading and/ or SCC.			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 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.
9	Heat exchangers and coolers/ condensers serviced by	Loss of material due to general (carbon steel only), pitting, and crevice corrosion,	Open-cycle cooling water system	No	Open Cycle Cooling Water Systems as described by NUREG-1801 are not used in any Steam and Power Conversion Systems at VCSNS.

Table 3.4-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR THE STEAM & POWER CONVERSION SYSTEMS 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
9 (cont.)	open-cycle cooling water	MIC, and biofouling; buildup of deposit due to biofouling	Open-cycle cooling water system	No	Open Cycle Cooling Water Systems as described by NUREG-1801 are not used in any Steam and Power Conversion Systems at VCSNS.
10	Heat exchangers and coolers/ condensers serviced by closed-cycle cooling water	Loss of material due to general (carbon steel only), pitting, and crevice corrosion	Closed-cycle cooling water system	No	Closed Cycle Cooling Water Systems as described by NUREG-1801 are not used in any Steam and Power Conversion Systems at VCSNS.
11	External surface of above ground condensate storage tank	Loss of material due general (carbon steel only), pitting, and crevice corrosion	Above ground carbon steel tanks	No	The component/component type AMR results for VCSNS are consistent with NUREG-1801 in material, environment, and aging effect. However, rather than an above ground carbon steel tanks program as recommended by NUREG-1801, general corrosion on external surfaces is detected and managed by

Table 3.4-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR THE STEAM & POWER CONVERSION SYSTEMS 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
11 (cont.)					Inspections for Mechanical Components (**Appendix B.2.11**) at VCSNS. Also, at VCSNS the ambient environment in the yard environment does not contain contaminants in sufficient quantities that could be concentrated in wetted locations to cause pitting corrosion and crevice corrosion, therefore, loss of material due to pitting corrosion and crevice corrosion has not been identified as an aging effect. Consistent with NUREG-1801, this group contains carbon steel in a yard environment. Consistent with NUREG-1801, this group contains external surfaces of the above ground Condensate Storage Tank.
12	External surface of buried condensate	Loss of material due to general, pitting, and crevice corrosion, and	Buried piping and tanks surveillance or Buried piping and	No Yes, detection of	The component/component type AMR results for VCSNS are consistent with NUREG-1801 in material, environment, aging effect, and credited program. The condensate storage

Table 3.4-1:

SUMMARY OF AGING MANAGEMENT PROGRAMS FOR THE STEAM & POWER CONVERSION SYSTEMS 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
12 (cont.)	storage tank and AFW piping	MIC	tanks inspection	aging effects and operating experience are to be further evaluated	tank is above ground, however, there is underground piping in the AFW (Emergency Feedwater System at VCSNS). Consistent with NUREG-1801, this group contains carbon steel in an underground (buried) environment. Consistent with NUREG-1801, this group includes external surfaces of piping and fittings. The Buried Pipe and Tanks Inspection program (**Appendix B.2.10**) will manage these aging effects/mechanisms at VCSNS.
13	External surface of carbon steel components	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 credited program. Consistent with NUREG-1801, this group

Table 3.4-1:

SUMMARY OF AGING MANAGEMENT PROGRAMS FOR THE STEAM & POWER CONVERSION SYSTEMS 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
13 (cont.)					contains external surfaces of carbon and low alloy steel components/component types in an air environment where there is a potential for leaking and dripping chemically treated borated water. In addition to these metals, this group also includes cast iron at VCSNS. The Boric Acid Corrosion Surveillances (**Appendix B.1.2**) will manage this aging effect/mechanism at VCSNS.

3.4.3.3 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 3.4-2. 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.

Table 3.4-2:
SUMMARY OF AGING MANAGEMENT EVALUATIONS FOR THE STEAM & POWER CONVERSION SYSTEMS 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	Ambient, 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 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	Aluminum, Brass	Ambient, moist air	Boric Acid Corrosion / Aggressive Chemical Attack	Boric Acid Corrosion Surveillances	The Boric Acid Corrosion Surveillances (**Appendix B.1.2**) will manage boric acid corrosion on external surfaces of components that are susceptible to this aging mechanism. No other aging mechanisms were

Table 3.4-2:
SUMMARY OF AGING MANAGEMENT EVALUATIONS FOR THE STEAM & POWER CONVERSION SYSTEMS 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
2 (cont.)						identified for this material/ environment combination at VCSNS.
3	Piping and piping components and heat exchanger tubes	Aluminum, Brass	Oil	None Identified	None Required	Water and contaminants will not intrude into the oil environments for these components/component types. This is supported by 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 operations.
4	EFWP Turbine (Casing	Carbon Steel	Ambient, moist air	General Corrosion	Preventive Maintenance Activities:	The Emergency Feedwater Pump turbine is normally in

Table 3.4-2:
SUMMARY OF AGING MANAGEMENT EVALUATIONS FOR THE STEAM & POWER CONVERSION SYSTEMS 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
4 (cont.)	Only), Valve (Body Only) EFWP Turbine Governor valve				Terry Turbine	a standby condition whereby the internal surfaces of these components are exposed to an ambient, moist air environment. Preventive Maintenance Activities: Terry Turbine (**Appendix B.1.25**) will manage this aging effect.
5	Valves (Bodies)	Stainless Steel	Treated Water	Crevice Corrosion, Pitting Corrosion, Stress Corrosion Cracking	Chemistry Program	The Chemistry Program (**Appendix B.1.4**) will manage crevice corrosion, pitting corrosion, and stress corrosion cracking for stainless steel valve bodies in a treated water environment during the period of extended operation.

Table 3.4-2:
SUMMARY OF AGING MANAGEMENT EVALUATIONS FOR THE STEAM & POWER CONVERSION SYSTEMS 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
6	Heat Exchanger EF Pump Turbine Lube Oil - Tube	Brass	Treated Water	Crevice Corrosion, Galvanic Corrosion, Pitting Corrosion, Selective Leaching, Stress Corrosion Cracking	Chemistry Program, Heat Exchanger Inspections	The Chemistry Program (**Appendix B.1.4**) will manage crevice corrosion, pitting corrosion, and galvanic corrosion of brass heat exchanger tubes in a treated water environment during the period of extended operation. Heat Exchanger Inspections (**Appendix B.2.12**) will manage selective leaching of brass heat exchanger tubes in a treated water environment during the period of extended operation.

3.4.4 REFERENCES

3.4-1	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.
3.4-2	NUREG-1801, "Generic Aging Lessons Learned Report," Volumes 1 and 2, NRC, April 2001.
3.4-3	NUREG-1800, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants," NRC, April 2001.

3.5 AGING MANAGEMENT OF CONTAINMENTS, STRUCTURES, AND COMPONENT SUPPORTS

3.5.1 CONTAINMENT, STRUCTURES, AND COMPONENT SUPPORTS DESCRIPTIONS

The Containment, Structures and Component Supports applicable to License Renewal at VCSNS include the following (for plant location see **Site Facilities Drawing**):

- Reactor Building (Internal Structures and Class 1 Component Supports)
- Auxiliary Building (includes Hot Machine Shop, Refueling Water Storage Tank & Reactor Makeup Water Storage Tank foundations and West Penetration Access Area)
- Control Building
- Intermediate Building (includes East Penetration Access Area)
- Diesel Generator Building
- Fuel Handling Building
- Turbine Building
- Service Water Pumphouse, Intake and Discharge Structures
- Yard Structures (includes Fire Service Pumphouse, Condensate Storage Tank foundation, and Electrical Manhole MH-2)
- Earthen Embankments (includes Service Water Pond North Dam, South Dam, East Dam, West Embankment and North Berm)
- Electrical Substation and Relay House

3.5.1.1 Reactor Building

The Reactor Building is a post tensioned, reinforced concrete structure with an integral steel liner. The Reactor Building consists of a cylindrical wall, a shallow dome roof and a foundation mat with a depressed incore instrumentation pit under the reactor vessel. The foundation mat bears on fill concrete that extends to competent rock. At the underside of the Reactor Building foundation mat a tendon access gallery is formed into the top of the fill concrete. A retaining wall, extending approximately one-quarter of the way around the Reactor Building, protects the below grade portions of the Reactor Building wall from the subgrade. Adjacent buildings surround the remaining three-quarters of the Reactor Building. The internal structures of the Reactor Building consist of the primary shield wall surrounding and supporting the reactor vessel; secondary shield walls surrounding and laterally supporting each steam generator and the pressurizer; refueling cavity and fuel transfer canal; mezzanine floor and operating floor, both consisting of concrete slabs supported by structural steel

framing; polar crane supports; and concrete basement slab supported by the structural foundation mat.

3.5.1.2 Auxiliary Building

The Auxiliary Building superstructure is a reinforced concrete shear wall (box type) structure containing five main floor levels above the foundation and extending up to elevation 485'-0" (designated as the roof). Above this level is another story composed primarily of a metal clad structural steel braced frame, but with limited areas continuing the reinforced concrete construction employed below. The foundation is comprised of a reinforced concrete structural mat which is supported on fill concrete down to competent bedrock. A waterproofing membrane is provided between the structural mat concrete and fill concrete because of the depth of the foundation below the ground water table.

3.5.1.3 Control Building

The Control Building superstructure is a steel frame structure with concrete exterior shear walls containing four main floor levels and a concrete roof. The foundation system for the Control Building (CB) is comprised of a reinforced concrete mat which is supported on fill concrete down to competent bedrock.

3.5.1.4 Intermediate Building

The Intermediate Building superstructure is a "L" shaped reinforced concrete shear wall (box type) structure containing two main floor levels above the foundation and extending up to a low roof. Above the low roof is a partial third floor of reinforced concrete. The foundation system for the Intermediate Building (IB) is comprised of a reinforced concrete basement floor slab that acts in conjunction with a series of grade beams to transfer vertical loads to reinforced concrete caissons, shear/bearing walls, and concrete piers. The shear/bearing wall foundations and reinforced concrete caissons are founded on competent bedrock. The piers are founded on fill concrete that extends beyond the Reactor Building and Auxiliary Building.

3.5.1.5 Diesel Generator Building

The Diesel Generator Building superstructure is a reinforced concrete shear wall (box type) structure containing three main floor levels above the foundation mat. The operating floor is where the diesel generators are located, with their foundations extending down to the basement floor mat. The foundation system for the Diesel Generator Building consists of a rein-

forced concrete slab and grade beam system that is supported by reinforced concrete caissons drilled into competent bedrock.

3.5.1.6 Fuel Handling Building

The Fuel Handling Building superstructure is a steel frame superstructure containing two main floor levels and a roof. The foundation system for the Fuel Handling Building is comprised of a reinforced concrete mat formed by the bottom of the Spent Fuel Pool and Fuel Cask Pit. The foundation mat is supported by reinforced concrete piers that extend to the fill concrete adjacent to the Reactor and Auxiliary Buildings and by reinforced concrete caissons that extend to competent rock on the north and east sides.

3.5.1.7 Turbine Building

The Turbine Building is a non Seismic Category I building. The superstructure (steel framing, metal siding and metal roof deck) is supported on a reinforced concrete substructure. The foundation for the Turbine Building is mostly comprised of a reinforced concrete mat supported by Zone III fill (graded crushed stone) material. The turbine generator pedestal foundation mat is founded on fill concrete.

3.5.1.8 Service Water Structures

The Service Water Pumphouse (SWPH) superstructure is a reinforced concrete building (containing three floor levels) constructed within the West Embankment of the Service Water Pond. The foundation is comprised of a reinforced concrete structural mat. The entire structural mat is supported on compact fill which extends from the underside of the mat. The compacted fill is supported on in-situ soils (saprolite), to decomposed rock, to competent rock. The SWPH structure is separate from the Service Water Intake Structure (SWIS) and from buried connecting pipes and electrical duct banks by flexible joints, which accommodate relative settlement and seismic movement. The SWIS is a reinforced concrete rectangular box culvert (tunnel) with two reinforced concrete wing walls at the intake end. The foundation for the SWIS forms the floor of the tunnel and is comprised of a reinforced concrete mat. The mat is supported by compacted fill material except for a portion of the inlet end which rests on in-situ soils. The Service Water Discharge Structure (SWDS) is a reinforced concrete rectangular basin mostly buried within the West Embankment of the Service Water Pond. The foundation is comprised of a reinforced concrete mat. The base mat bears partly on decomposed rock and partly on fill concrete that extends to the decomposed rock.

3.5.1.9 Yard Structures

Yard Structures include the Condensate Storage Tank Foundation, Electrical Manhole EH-2, and the Fire Service Pumphouse. The Condensate Storage Tank (CST) foundation consists of a reinforced concrete mat which is supported by a Zone III fill (graded crushed stone) material. A reinforced concrete ring wall extends above the foundation mat which secures the CST with anchor bolts. Electrical Manhole EH-2 is a reinforced concrete structure which contains electrical duct banks for Class 1E cables. The manhole is mostly embedded below the yard grade, with reinforced concrete walls and foundation mat. The Fire Service Pumphouse is a concrete block building (with composite roof) founded upon the reinforced concrete Circulating Water Intake Structure (CWIS). This non-safety structure is included within License Renewal in compliance with 10CFR50.48 (Fire Protection). The Electrical Substation yard, with the exception of the paved roadways, is covered with several inches of "crusher run" stone and is enclosed by a perimeter fence. The Electrical Substation and Transformer Area are included within License Renewal in compliance with the NRC revised staff position on the scoping of SBO equipment for license renewal dated 4/1/2002.

3.5.1.10 Earthen Embankments

The Earthen Embankments (North Dam, South Dam, and East Dam and the West Embankment) form the Service Water Pond. These earthen structures are Seismic Category I and were designed to satisfy the intent of Regulatory Guides 1.27 and 1.29. The three dams and West Embankment are homogeneous earth structures with fill material consisting of residual soil and saprolite which was excavated from local borrow sources. The shoreline along Monticello Reservoir north of the plant and west of the North Dam has an earthen dike (North Berm) constructed above the site grade. The North Berm is classified as a non-seismic, non-nuclear safety-related structure. The primary function of the North Berm is to protect the site from the potential of external flooding from Monticello Reservoir (due to probable maximum precipitation and wave run-up).

3.5.1.11 Class 1 Component Supports

Class 1 Component Supports are those supports for major equipment and Class 1 piping that are subject to aging management review including: Class 1 piping supports and major equipment supports (pressurizer base flange and upper lateral supports; reactor vessel supports; steam generator vertical, lower lateral, and upper lateral supports; and reactor coolant pump lateral and vertical support assemblies).

3.5.2 AGING MANAGEMENT REVIEW

3.5.2.1 Methodology

Aging management review of Containment, Structures and Component Supports involved consideration and evaluation of the materials, environments, and stressors that are associated with each structure, component, or commodity grouping under review, as discussed in Section 4.2 of NEI 95-10 [**Reference 3.5-1**]. 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 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 3.5-2**] and evaluated for consistency with NUREG-1801 programs that are relied on for license renewal. The results are documented and discussed in Table 3.5-1 using the format suggested by the NRC Standard Review Plan for License Renewal (NUREG-1800) [**Reference 3.5-3**].

3.5.2.2 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.

3.5.3 AGING MANAGEMENT PROGRAM

3.5.3.1 Aging Management Programs Evaluated In NUREG-1801 That Are Relied On For License Renewal

Table 3.5-1 shows the aging management groups (combinations of components, materials and aging effects) and the aging management programs evaluated in NUREG-1801 that are relied on for license renewal of the Containment, Class I Structures, and Component Supports at VCSNS. Note that this table only includes those components, materials and aging effects that are applicable to a PWR. The VCSNS comparison to NUREG-1801 (including clarifications and exceptions) is included in the "Discussion" column.

3.5.3.2 Further Evaluation Of Aging Management As Recommended By NUREG-1801

Further evaluation of aging management as recommended by the NUREG-1801 has been incorporated into the "Discussion" column of Table 3.5-1.

Table 3.5-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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
Common Components of All Types of PWR Containment					
1	Penetration sleeves, penetration bellows, and dissimilar metal welds	Cumulative fatigue damage (CLB fatigue analysis exists)	TLAA evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA	VCSNS does not evaluate fatigue for penetration sleeves, bellows or dissimilar metal welds; therefore, a TLAA evaluation is not applicable. **Penetration Sleeves** meet the requirements of ASME Section III, comply with GDC-51, and behave in a non-brittle manner. **Penetration Bellows** are used in hot penetrations at VCSNS but do not provide containment isolation since they are located within the penetration on the exterior side of containment. Hot penetrations are sealed on the inside of containment by a flat plate welded to both the penetration sleeve and process pipe (similar to cold penetrations), thus providing

Table 3.5-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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 (cont.)					containment isolation without the use of a resilient or flexible seal. **Dissimilar Metal Welds** are materials and not components. VCSNS penetration sleeves and process pipes use similar (SA) materials.
2	Penetration sleeves, bellows, and dissimilar metal welds	Cracking due to cyclic loading; crack initiation and growth due to SCC	Containment inservice inspection (ISI) and containment leak rate test	Yes, detection of aging effects is to be evaluated	VCSNS Aging Management Programs: 10 CFR 50 Appendix J General Visual Inspection (**Appendix B.1.11**), 10 CFR 50 Appendix J Leak Rate Testing (**Appendix B.1.12**) and Containment ISI Program - IWE/IWL (**Appendix B.1.16**) are consistent with those reviewed and approved in NUREG-1801. Stress Corrosion Cracking (SCC) requires a combination of a corrosive environment, susceptible materials, and high tensile stresses. (1) VCSNS penetration sleeves are not

Table 3.5-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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
2 (cont.)					subject to high tensile stresses or aggressive chemicals during normal operation, while similar metal welds are used between penetration sleeves and process pipes; therefore, SCC is not an applicable aging effect requiring management. (2) VCSNS hot penetration bellows do not perform a pressure boundary function nor incorporate a flexible seal assembly on the inboard side of containment. They do provide structural and/or functional support for process piping on the outboard side of containment; therefore, in the unlikely event of SCC in the bellows, the intended functions are not affected.
3	Penetration sleeves, penetration bellows, and	Loss of material due to corrosion	Containment ISI and Containment leak rate test	No	VCSNS Aging Management Programs: 10 CFR 50 Appendix J General Visual Inspection (**Appendix B.1.11**), 10 CFR 50 Appendix J Leak Rate Testing (**Appendix B.1.12**) and

Table 3.5-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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.)	dissimilar metal welds				Containment ISI Program - IWE/IWL (**Appendix B.1.16**) are consistent with those reviewed and approved in NUREG-1801.
4	Personnel airlock and equipment hatch	Loss of material due to corrosion	Containment ISI and Containment leak rate test	No	VCSNS Aging Management Programs: 10 CFR 50 Appendix J General Visual Inspection (**Appendix B.1.11**), 10 CFR 50 Appendix J Leak Rate Testing (**Appendix B.1.12**) and Containment ISI Program - IWE/IWL (**Appendix B.1.16**) are consistent with those reviewed and approved in NUREG-1801.
5	Personnel airlock and equipment hatch	Loss of leak tightness in closed position due to mechanical wear of locks, hinges, and closure mechanisms	Containment leak rate test and plant technical specifications	No	VCSNS Aging Management Programs: 10 CFR 50 Appendix J General Visual Inspection (**Appendix B.1.11**), 10 CFR 50 Appendix J Leak Rate Testing (**Appendix B.1.12**) and Containment ISI Program - IWE/IWL (**Appendix B.1.16**) are consistent with those reviewed and approved in NUREG-1801.

Table 3.5-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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
5 (cont.)					Operation of hatches is governed by VCSNS Technical Specifications. Plant operational experience has not identified any fretting or seal degradation. Locks, hinges, and closure mechanisms are active components; therefore, mechanical wear is not considered an aging effect.
6	Seals, gaskets, and moisture barriers	Loss of sealant and leakage through containment due to deterioration of joint seals, gaskets, and moisture barriers	Containment ISI and Containment leak rate test	No	Loss of sealing is not considered an aging effect, but rather a consequence of elastomer degradation which is managed by the programs: 10 CFR 50 Appendix J General Visual Inspection (**Appendix B.1.11**), 10 CFR 50 Appendix J Leak Rate Testing (**Appendix B.1.12**), Containment ISI Program - IWE/IWL (**Appendix B.1.16**) and Maintenance Rule Structures Program (**Appendix B.1.18**) which are consistent with those reviewed and

Table 3.5-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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
6 (cont.)					approved in NUREG-1801. Component types include: moisture barrier, compressible joints and seals used for seismic gaps, and fire barrier seals. These components are managed by the Containment ISI, IWE and Maintenance Rule Structures Programs.
PWR Concrete (Reinforced and Prestressed) and Steel Containment					
7	Concrete elements: foundation, dome, and wall	Aging of accessible and inaccessible concrete areas due to leaching of calcium hydroxide, aggressive chemical attack, and	Containment ISI	Yes, if aging mechanism is significant for inaccessible areas	**ACCESSIBLE AREAS** VCSNS Aging Management Programs: 10 CFR 50 Appendix J General Visual Inspection (**Appendix B.1.11**) and Containment ISI Program - IWE/IWL (**Appendix B.1.16**) are consistent with those reviewed and approved in NUREG-1801.

Table 3.5-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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
7 (cont.)		corrosion of embedded steel			**Leaching of Calcium Hydroxide** from reinforced concrete becomes significant only if the concrete is exposed to flowing water. Resistance to leaching is enhanced by using a dense concrete with low permeability and well cured. The VCSNS containment structure is not exposed to flowing water and designed in accordance with ACI-318 and constructed in accordance with ACI-301 and ASTM Standards, which provides a good quality, dense, low permeability concrete. Leaching has been identified in the accessible containment Tendon Access Gallery (due to groundwater infiltration) and is managed by the programs: 10 CFR 50 Appendix J General Visual Inspection (**Appendix B.1.11**) and Containment ISI Program - IWE/IWL (**Appendix B.1.16**).

Table 3.5-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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
7 (cont.)					**Aggressive Chemical Attack** becomes significant to concrete exposed to an aggressive environment (Chlorides > 500 ppm, Sulfates > 1500 ppm, and pH < 5.5). Resistance to mild acid attack is enhanced by using a dense concrete with low permeability and a low water-to-cement ratio of less than 0.50. The VCSNS containment structure uses a dense, low permeable concrete with a maximum water-to-cement ratio of 0.48, which provides an acceptable degree of protection against aggressive chemical attack. VCSNS is not located in areas exposed to sulfate or chloride attack, nor located near industrial plants whose emissions would change environmental parameters and cause degradation to concrete. The water chemical

Table 3.5-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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
7 (cont.)					analysis results confirm that the site ground-water is mildly acidic but considered to be non-aggressive. Therefore, loss of material due to aggressive chemical attack is not an aging effect requiring management for acces-sible containment concrete structures. Peri-odic monitoring of the below grade water chemistry will be conducted during the period of extended operation to demonstrate that the below-grade environment is not aggressive. **Corrosion of Embedded Steel** becomes sig-nificant if exposed to an aggressive environ-ment (Concrete pH < 11.5 and Chlorides > 500 ppm). Corrosion is not significant if the concrete has a low water-to-cement ratio, low permeability, and designed in accordance with ACI Standards (ACI-318 or ACI-349). The

Table 3.5-1:
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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
7 (cont.)					design and construction of the VCSNS containment structure (in accordance with accepted ACI Standards) prevents corrosion of embedded steel from occurring; therefore, this aging effect does not require management for accessible areas. **INACCESSIBLE AREAS** Inaccessible Areas at VCSNS do not require a plant-specific aging management program for leaching of calcium hydroxide, aggressive chemical attack or corrosion of embedded steel due to the following: • Containment concrete surfaces are not exposed to flowing water and the in-place concrete is constructed to design

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SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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
7 (cont.)					requirements in accordance with ACI recommendations (at the time of construction) which produced a dense concrete with low permeability. Specific reference to ACI 201.2R-77 is not made since the plant was designed and constructed prior to 1977. • Concrete is not exposed to a below grade environment which is considered aggressive. Refer above to "Aggressive Chemical Attack" for "Accessible Areas." Additionally, VCSNS used a concrete design mix with maximum water-cement ratio of 0.44 - 0.48 which is specified by ACI Standards to be chemically resistant and watertight. Periodic monitoring of the below grade water chemistry will be conducted during the period of extended operation to demonstrate that the below-grade environment is

Table 3.5-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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
7 (cont.)					not aggressive.
8	Concrete elements: foundation	Cracks, distortion, and increases in component stress level due to settlement	Structures monitoring	No, if within the scope of the applicant's structures monitoring program	VCSNS Aging Management Programs: 10 CFR 50 Appendix J General Visual Inspection (**Appendix B.1.11**), Containment ISI Program - IWE/IWL (**Appendix B.1.16**) and Maintenance Rule Structures Program (**Appendix B.1.18**) are consistent with those reviewed and approved in NUREG-1801. The VCSNS containment foundation is constructed directly on competent bedrock and is not subject to settlement; therefore, aging management is not required.
9	Concrete elements: foundation	Reduction in foundation strength due to erosion of	Structures monitoring	No, if within the scope of the applicant's	The VCSNS containment foundation does not use porous concrete and is not subject to flowing water; therefore, aging management is

Table 3.5-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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
9 (cont.)		porous concrete subfoundation		structures monitoring program	not required.
10	Concrete elements: foundation, dome, and wall	Reduction of strength and modulus due to elevated temperature	Plant specific	Yes, for any portions of concrete containment that exceed specified temperature limits	The VCSNS containment concrete elements are not exposed to temperatures which exceed the thresholds for degradation; therefore, reduction of strength and modulus due to elevated temperatures are not aging effects requiring management.
11	Prestressed containment: tendons and anchorage components	Loss of prestress due to relaxation, shrinkage, creep, and elevated temperature	TLAA evaluated in accordance with 10 CFR 54.21 (c)	Yes, TLAA	VCSNS Aging Management Programs: Containment ISI Program - IWE/IWL (**Appendix B.1.16**) and Tendon Surveillance Program (**Appendix B.3.3**) are consistent with those reviewed and approved in NUREG-1801. VCSNS Containment tendons have been determined to be a TLAA in accordance with 10 CFR 54.3. Refer to **Section 4.5**.

Table 3.5-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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
12	Steel elements: liner plate and containment shell	Loss of material due to corrosion in accessible and inaccessible areas	Containment ISI and containment leak rate test	Yes, if corrosion is significant for inaccessible areas	VCSNS Aging Management Programs: 10 CFR 50 Appendix J General Visual Inspection (**Appendix B.1.11**), 10 CFR 50 Appendix J Leak Rate Testing (**Appendix B.1.12**), Containment Coating Monitoring And Maintenance Program (**Appendix B.1.15**) and Containment ISI Program - IWE/IWL (**Appendix B.1.16**) are consistent with those reviewed and approved in NUREG-1801. Corrosion for inaccessible areas (embedded containment liner) is not significant because: • Concrete meeting the requirements of ACI-318 or ACI-349 and the guidance of ACI-201.2R was used for the containment concrete in contact with the embedded containment liner.

Table 3.5-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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
12 (cont.)					• The concrete is monitored under Maintenance Rule Structures Program and IWL to ensure that it is free of penetrating cracks. • The moisture barrier is monitored under IWE for aging degradation. • Borated water leakage in the containment structure is not a common occurrence and is monitored under the aging management program Boric Acid Corrosion Surveillances (**Appendix B.1.2**).
13	Steel elements: protected by coating	Loss of material due to corrosion in accessible areas only	Protective coating monitoring and maintenance	No	VCSNS Aging Management Programs: 10 CFR 50 Appendix J General Visual Inspection (**Appendix B1.11**), Containment Coating Monitoring and Maintenance Program (**Appendix B.1.15**), Containment ISI Program - IWE/IWL (**Appendix B.1.16**) and Maintenance Rule Structures Program (**Appendix B.1.18**) are consistent with those

Table 3.5-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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
13 (cont.)					reviewed and approved in NUREG-1801.
14	Prestressed containment: tendons and anchorage components	Loss of material due to corrosion of prestressing tendons and anchorage components	Containment ISI	No	VCSNS Aging Management Programs: Containment ISI Program - IWE/IWL (**Appendix B.1.16**) and Tendon Surveillance Program (**Appendix B.3.3**) are consistent with those reviewed and approved in NUREG-1801.
15	Concrete elements: foundation, dome, and wall	Scaling, cracking, and spalling due to freeze-thaw; expansion and cracking due to reaction with aggregate	Containment ISI	No	**ACCESSIBLE AREAS** VCSNS Aging Management Programs: 10 CFR 50 Appendix J General Visual Inspection (**Appendix B.1.11**), Containment ISI Program - IWE/IWL (**Appendix B.1.16**), and Maintenance Rule Structures Program (**Appendix B.1.18**) are consistent with those reviewed and approved in NUREG-1801.

Table 3.5-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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
15 (cont.)					**Freeze-thaw** is not an aging effect requiring management for the containment structure at VCSNS, since it is not exposed to saturated water conditions and is designed and constructed to acceptable ACI and ASTM Standards. **Reaction with Aggregates** for the containment structure at VCSNS is mitigated by carefully designed and selected concrete constituents; therefore, expansion and cracking due to reaction with aggregates is not an aging effect requiring management. **INACCESSIBLE AREAS** **Inaccessible Areas** at VCSNS do not require

Table 3.5-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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
15 (cont.)					a plant-specific aging management program for freeze-thaw or reaction with aggregates due to the following: • VCSNS lies within the "moderate" weathering region of the U. S. (as defined in ASTM C33) and its containment concrete is not exposed to saturated water conditions near the ground surface which eliminates freeze-thaw considerations. Additionally, The concrete used at VCSNS is designed with entrained air content of between 4% and 6% in conformance with ACI-301, and IWL inspections have not identified any concrete degradation related to freeze-thaw. • Aggregates used in concrete at VCSNS were carefully selected (using local

Table 3.5-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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
15 (cont.)					quarries) to mitigate aggregate reactions, incorporating design specifications in conformance with accepted ACI and ASTM Standards.
Class I Structures					
16	All Groups except Group 6: accessible interior/exterior concrete and steel components	All types of aging effects	Structures monitoring	No, if within the scope of the applicant's structures monitoring program	**ACCESSIBLE AREAS** VCSNS Aging Management Programs: described in Containment Coating Monitoring and Maintenance Program (**Appendix B.1.15**), Containment ISI Program - IWE/IWL (**Appendix B.1.16**) and Maintenance Rule Structures Program (**Appendix B.1.18**) are consistent with those reviewed and approved in NUREG-1801. **Freeze-thaw** is not an aging effect requiring

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SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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
16 (cont.)					management for these groups of structures at VCSNS, since they are not exposed to saturated water conditions and are designed and constructed to acceptable ACI and ASTM Standards. **Leaching of Calcium Hydroxide** from reinforced concrete becomes significant only if the concrete is exposed to flowing water. Resistance to leaching is enhanced by using a dense concrete with low permeability. These groups of structures at VCSNS are not exposed to flowing water and designed in accordance with ACI-318 and constructed in accordance with ACI-301 and ASTM Standards, which provides a good quality, dense, low permeability concrete.

Table 3.5-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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
16 (cont.)					**Reaction with Aggregates** for concrete for these groups of structures at VCSNS are mitigated by carefully designed and selected concrete constituents; therefore, expansion and cracking due to reaction with aggregates is not an aging effect requiring management. **Corrosion of Embedded Steel** becomes significant if exposed to an aggressive environment (Concrete pH < 11.5 and Chlorides > 500 ppm). Corrosion is not significant if the concrete has a low water-to-cement ratio, low permeability, and designed in accordance with ACI Standards (ACI-318 or ACI-349). The design and construction of these groups of structures at VCSNS prevents corrosion of embedded steel from occurring; therefore, this aging effect does not require management for

Table 3.5-1:
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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
16 (cont.)					accessible areas. **Aggressive Chemical Attack** becomes significant to concrete exposed to an aggressive environment (Chlorides > 500 ppm, Sulfates > 1500 ppm, and pH < 5.5). Resistance to mild acid attack is enhanced by using a dense concrete with low permeability and a low water-to-cement ratio of less than 0.50. These groups of structures at VCSNS use a dense, low permeable concrete with a maximum water-to-cement ratio of 0.48, which provides an acceptable degree of protection against aggressive chemical attack. VCSNS is not located in areas exposed to sulfate or chloride attack, nor located near industrial plants whose emissions would change environmental parameters and cause degradation to

Table 3.5-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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
16 (cont.)					concrete. The water chemical analysis results confirm that the site groundwater is considered to be non-aggressive; therefore, loss of material due to aggressive chemical attack is not an aging effect requiring management. Periodic monitoring of the below grade water chemistry will be conducted during the period of extended operation to demonstrate that the below-grade environment is not aggressive. **Corrosion** of structural steel components is managed by the Maintenance Rule Structures Program (**Appendix B.1.18**). **Lubrite** materials are not used at VCSNS in the reactor pressure vessel supports; therefore, aging management is not required.

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
16 (cont.)					**INACCESSIBLE AREAS** **Inaccessible Areas** at VCSNS do not require a plant-specific aging management program for freeze-thaw, leaching of calcium hydroxide, reaction with aggregates, corrosion of embedded steel or aggressive chemical attack due to the following: • VCSNS lies within the "moderate" weathering region of the U. S. (as defined in ASTM C33) and its concrete is not exposed to saturated water conditions near the ground surface which eliminates freeze-thaw considerations. Additionally, the concrete used at VCSNS is designed with entrained air content of between 4% and 6% in conformance with ACI-301, and Maintenance Rule

Table 3.5-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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
16 (cont.)					inspections have not identified any degradation related to freeze-thaw. • Concrete surfaces are not exposed to flowing water and the in-place concrete is constructed with design requirements in accordance with ACI recommendations (at the time of construction) which produced a dense concrete with low permeability. Specific reference to ACI 201.2R-77 is not made since the plant was designed and constructed prior to 1977. • Aggregates used in concrete at VCSNS were carefully selected (using local quarries) to mitigate aggregate reactions, incorporating design specifications in conformance with accepted ACI and ASTM Standards. • Concrete is not exposed to a below grade

Table 3.5-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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
16 (cont.)					environment which is considered aggressive. Additionally, VCSNS used a concrete design mix with maximum water-cement ratio of 0.44 - 0.48 which is specified by ACI Standards to be chemically resistant and watertight. Periodic monitoring of the below grade water chemistry will be conducted during the period of extended operation to demonstrate that the below-grade environment is not aggressive.
17	Groups 1-3, 5, 7-9; inaccessible concrete components, such as	Aging of inaccessible concrete areas due to aggressive chemical attack, and corrosion of	Plant specific	Yes, if an aggressive below-grade environment exists	**Aggressive Chemical Attack** becomes significant to concrete exposed to an aggressive environment (Chlorides > 500 ppm, Sulfates > 1500 ppm, and pH < 5.5). Resistance to mild acid attack is enhanced by using a dense concrete with low permeability and a low water-to-cement ratio of less than 0.50. These groups of structures at VCSNS use a dense,

Table 3.5-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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
17 (cont.)	exterior walls below grade and foundation	embedded steel			low permeable concrete with a maximum water-to-cement ratio of 0.48, which provides an acceptable degree of protection against aggressive chemical attack. The water chemical analysis results confirm that the site groundwater is considered to be non-aggressive. Therefore, loss of material due to aggressive chemical attack is not an aging effect requiring management for inaccessible concrete components. Periodic monitoring of the below grade water chemistry will be conducted during the period of extended operation to demonstrate that the below-grade environment is not aggressive. **Corrosion of Embedded Steel** becomes significant if exposed to an aggressive environment (Concrete pH < 11.5 and Chlorides

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
17 (cont.)					> 500 ppm). Corrosion is not significant if the concrete has a low water-to-cement ratio, low permeability, and designed in accordance with ACI Standards (ACI-318 or ACI-349). The design and construction (in accordance with accepted ACI Standards) of these groups of structures at VCSNS prevents corrosion of embedded steel from occurring; therefore, this aging effect does not require management for inaccessible areas.
18	Group 6: all accessible/ inaccessible concrete, steel, and earthen	All types of aging effects, including loss of material due to abrasion, cavitation, and corrosion	Inspection of water-control structures or FERC/US Army Corp of Engineers dam inspection	No	**ACCESSIBLE AREAS** VCSNS Aging Management Programs: Maintenance Rule Structures Program (**Appendix B.1.18**) and Service Water Pond Dam Inspection Program (**Appendix B.1.21**) are consistent with those reviewed and approved in NUREG-1801. In addition, VCSNS

Table 3.5-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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
18 (cont.)	components	All types of aging effects, including loss of material due to abrasion, cavitation, and corrosion	and maintenance	No	incorporates other programs: Service Water Structures Survey Monitoring Program (**Appendix B.1.22**) and Underwater Inspection Program (SWIS and SWPH) (**Appendix B.1.23**). **Freeze-thaw** is an aging effect requiring management for these structures at VCSNS, since they are exposed to saturated water conditions. This aging effect is minimized since these structures are designed and constructed to acceptable ACI and ASTM Standards. **Leaching of Calcium Hydroxide** from reinforced concrete becomes significant only if the concrete is exposed to flowing water. Resistance to leaching is enhanced by using a dense concrete with low permeability and well

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SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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
18 (cont.)					cured. These structures at VCSNS are designed in accordance with ACI-318 and constructed in accordance with ACI-301 and ASTM Standards, which provides a good quality, dense, low permeability concrete. **Reaction with Aggregates** for concrete for these structures at VCSNS are mitigated by carefully designed and selected concrete constituents; therefore, expansion and cracking due to reaction with aggregates is not an aging effect requiring management. **Corrosion of Embedded Steel** becomes significant if exposed to an aggressive environment (Concrete pH < 11.5 and Chlorides > 500 ppm). Corrosion is not significant if the concrete has a low water-to-cement ratio, low

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
18 (cont.)					permeability, and designed in accordance with ACI Standards (ACI-318 or ACI-349). The design and construction (in accordance with accepted ACI Standards) of these structures at VCSNS prevents corrosion of embedded steel from occurring; therefore, this aging effect does not require management for accessible areas. **Aggressive Chemical Attack** becomes significant to concrete exposed to an aggressive environment (Chlorides > 500 ppm, Sulfates > 1500 ppm, and pH < 5.5). Resistance to mild acid attack is enhanced by using a dense concrete with low permeability and a low water-to-cement ratio of less than 0.50. These structures at VCSNS use a dense, low permeable concrete with a maximum water-to-cement

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
18 (cont.)					ratio of 0.48, which provides an acceptable degree of protection against aggressive chemical attack. VCSNS is not located in areas exposed to sulfate or chloride attack, nor located near industrial plants whose emissions would change environmental parameters and cause degradation to concrete. The water chemical analyses results confirm that the site groundwater, pond and reservoir are considered to be non-aggressive; therefore, loss of material due to aggressive chemical attack is not an aging effect requiring management. Periodic monitoring of the below grade water chemistry will be conducted during the period of extended operation to demonstrate that the below-grade environment is not aggressive.

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SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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
18 (cont.)					**Settlement** of these structures at VCSNS is monitored and managed by the programs: Service Water Pond Dam Inspection Program (**Appendix B.1.21**) and Service Water Structures Survey Monitoring Program (**Appendix B.1.22**). **Abrasion and Cavitation** due to flowing water are considered insignificant at VCSNS due to the low flow conditions designed for these structures; therefore, aging management is not required. **Corrosion** of structural steel components is managed by the programs: Maintenance Rule Structures Program (**Appendix B.1.18**) and Underwater Inspection Program (SWIS and

Table 3.5-1:
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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
18 (cont.)					SWPH) (**Appendix B.1.23**). **Earthen Structures** are monitored and managed by the programs: Service Water Pond Dam Inspection Program (**Appendix B.1.21**) and Service Water Structures Survey Monitoring Program (**Appendix B.1.22**). **INACCESSIBLE AREAS** **Inaccessible Areas** at VCSNS do not require a plant-specific aging management program for freeze-thaw, leaching of calcium hydroxide, reaction with aggregates, corrosion of embedded steel or aggressive chemical attack due to the following: • VCSNS lies within the "moderate"

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
18 (cont.)					weathering region of the U. S. (as defined in ASTM C33). These concrete structures are exposed to saturated water conditions near the ground surface; however, the concrete used at VCSNS is designed with entrained air content of between 4% and 6% in conformance with ACI-301, and Maintenance Rule inspections have not identified any degradation related to freeze-thaw. • Portions of concrete surfaces for these structures are exposed to flowing water; however, the in-place concrete was constructed with design requirements in accordance with ACI recommendations at the time of construction which produce a dense concrete with low permeability. Specific reference to ACI 201.2R-77 is not

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SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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
18 (cont.)					made since the plant was designed and constructed prior to 1977. • Aggregates used in concrete at VCSNS were carefully selected (using local quarries) to mitigate aggregate reactions, incorporating design specifications in conformance with accepted ACI and ASTM Standards. • Concrete is not exposed to a below grade environment which is considered aggressive. Additionally, VCSNS used a concrete design mix with maximum water-cement ratio of 0.44 - 0.48 which is specified by ACI Standards to be chemically resistant and watertight. Periodic monitoring of the below grade water chemistry will be conducted during the period of extended operation to demonstrate that the below-grade

Table 3.5-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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
18 (cont.)					environment is not aggressive.
19	Group 5: liners	Crack initiation and growth due to SCC; loss of material due to crevice corrosion	Water chemistry and monitoring of spent fuel pool water level	No	VCSNS Aging Management Programs: Chemistry Program (**Appendix B.1.4**) and Maintenance Rule Structures Program (**Appendix B.1.18**) are consistent with those reviewed and approved in NUREG-1801.
20	Groups 1-3, 5, 6: all masonry block walls	Cracking due to restraint, shrinkage, creep, and aggressive environment	Masonry wall	No	Masonry walls at VCSNS are inspected in accordance with the Maintenance Rule Structures Program (**Appendix B.1.18**). No masonry walls are used in nuclear safety-related structures at VCSNS.
21	Groups 1-3, 5, 7-9: foundation	Cracks, distortion, and increases in component stress	Structures monitoring	No, if within the scope of the applicant's structures monitoring	VCSNS Aging Management Program: Maintenance Rule Structures Program (**Appendix B.1.18**) is consistent with those reviewed and approved in NUREG-1801.

Table 3.5-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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
21 (cont.)		level due to settlement		program	Concrete Tanks are not used at VCSNS; therefore, aging management is not required.
22	Groups 1-3, 5-9: foundation	Reduction in foundation strength due to erosion of porous concrete subfoundation	Structures monitoring	No, if within the scope of the applicant's structures monitoring program	The VCSNS structure foundations do not use porous concrete; therefore, aging management is not required. Concrete Tanks are not used at VCSNS; therefore, aging management is not required.
23	Groups 1-5: concrete	Reduction in strength and modulus due to elevated temperature	Plant specific	Yes, for any portions of concrete that exceed specified temperature limits	The VCSNS structural concrete elements are not exposed to temperatures which exceed the thresholds for degradation; therefore, reduction of strength and modulus due to elevated temperatures are not aging effects requiring management.
24	Group 7, 8: liners	Crack initiation and growth due to	Plant specific	Yes	Group 7 (Concrete Tanks) are not used at VCSNS; therefore, aging management is not

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
24 (cont.)		SCC; loss of material due to crevice corrosion			required. Note that the combinations of components, materials, and environments ied in NUREG-1801 for Group 8 (Steel Tanks) are not applicable to VCSNS; therefore, aging management is not required.
Component Supports					
25	All Groups: support members: anchor bolts, concrete surrounding anchor bolts, welds, grout pad, bolted	Aging of component supports	Structures monitoring	No, if within the scope of the applicant's structures monitoring program	VCSNS Aging Management Programs: 10 CFR 50 Appendix J General Visual Inspection (**Appendix B.1.11**) and Maintenance Rule Structures Program (**Appendix B.1.18**) are consistent with those reviewed and approved in NUREG-1801. Concrete structures and concrete components can be subjected to cyclic loading and

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AMR Item	Component Group	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
25 (cont.)	connections, etc.				therefore, can be subjected to fatigue degradation. However, concrete components have good fatigue strength properties for hundreds or thousands or cycles of below yield load application (high cycle low-level loads). For components that may be subjected to vibratory or cyclic loading, proper design eliminates or compensates for vibration and cyclic loading. In addition, vibration characteristically leads to cracking in a short period of time, on the order of hours to days of operation. For example, a component with 1 Hertz vibratory load will be subjected to 10^7 cycles in four months of service, so that failure, should it occur, is probable early in life for vibratory stresses above the endurance limit. Because this time period is short when compared to the overall plant operational life, any cracking

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SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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
25 (cont.)					would be identified and corrected to prevent recurrence long before the period of extended operation. This type of degradation is limited to a small set of components and is corrected as discovered with inspections of similar locations and configurations to ensure the event is location specific or a one-time event. The potential for cracking induced by other cyclic loads, such as thermal cycling of the supported system, is implicitly considered in structural steel design through the specification of conservative design allowable stresses that account for a minimum of 10^5 load cycles. VCSNS concrete components are designed in accordance with accepted ACI Standards and have good low cycle fatigue properties. Plant

Table 3.5-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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
25 (cont.)					experience did not identify any concrete degradation due to service-induced loads. Therefore, cracking due to fatigue is not an aging effect requiring management for concrete components.
26	Groups B1.1, B1.2, and B1.3: support members: anchor bolts, and welds	Cumulative fatigue damage (CLB fatigue analysis exists)	TLAA evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA	TLAA is not applicable since a CLB fatigue analyses does not exist for these component types at VCSNS.
27	All Groups: support members: anchor bolts and welds	Loss of material due to boric acid corrosion	Boric acid corrosion	No	VCSNS Aging Management Programs: Boric Acid Corrosion Surveillances (**Appendix B.1.2**), 10 CFR 50 Appendix J General Visual Inspection (**Appendix B.1.11**) and Maintenance Rule Structures Program

Table 3.5-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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
27 (cont.)					(**Appendix B.1.18**) are consistent with those reviewed and approved in NUREG-1801.
28	Groups B1.1, B1.2, and B1.3: support members: anchor bolts, welds, spring hangers, guides, stops, and vibration isolators	Loss of material due to environmental corrosion; loss of mechanical function due to corrosion, distortion, dirt, overload, etc.	ISI	No	VCSNS Aging Management Programs: 10 CFR 50 Appendix J General Visual Inspection (**Appendix B.1.11**) and Maintenance Rule Structures Program (**Appendix B.1.18**) are consistent with those reviewed and approved in NUREG-1801. Loss of mechanical function, distortion, dirt, overload, fatigue due to vibratory and cyclic thermal loads; and elastomer hardening are not considered as aging effects but rather design issues.
29	Groups B1.1: high strength low-alloy	Crack initiation and growth due to SCC	Bolting integrity	No	Bolting integrity at VCSNS is inspected in accordance with the ISI Program (IWF): ASME Section XI ISI Program – IWF

Table 3.5-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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
29 (cont.)	bolts				(**Appendix B.1.13**). Industry experience has shown that high strength bolts (bolts with tensile strength greater than 150 ksi) installed in Class 1 component supports could be susceptible to SCC in humid environments like the Reactor Building. The key factors necessary for SCC include high-strength materials, moist environments, and a high level of sustained tensile stress. Operating experience also shows that improperly heat-treated anchor bolts have been susceptible to SCC, especially when under a high preload (full preload of 70% of ultimate strength). Anchor bolts are also exposed to concrete where chlorides can leach-out and attack the intergranular structure of the bolts over time. Therefore based on

Table 3.5-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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
29 (cont.)					industry experience, stress corrosion cracking is a potential aging effect for the ASTM A490 high strength anchor bolts used in the Class 1 component supports at VCSNS. However, SCC of high strength anchor bolts should also be considered as a negligible aging effect at VCSNS since the following conditions apply: • ASTM A490 anchor bolt material is properly heat-treated by conforming to ASTM Specification A490 through a certified mill test report. • Anchor bolts are tightened snug-tight as defined by AISC; therefore, for bolts greater than 1" in diameter, a significant preload (in the order of 70% of ultimate

Table 3.5-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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
29 (cont.)					strength) is not practical to develop. • Anchor bolts do not have a high level of sustained tensile stress as evidenced by lower faulted condition design loads due to elimination of dynamic effects subsequent to postulated High Energy Line Break (HELB) of the Reactor Coolant System primary coolant piping.

3.5.3.3 Aging Management Evaluations That Are Different From Or Not Addressed In NUREG-1801

Table 3.5-2 contains Containment, Structures and Component Supports aging management review results that are not specifically addressed in NUREG-1801. This table includes component types, materials, environments and aging effects requiring management, along with the programs and activities for managing aging.

Table 3.5-2:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS
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	Battery Racks	Carbon Steel	Internal	Loss of Material (General Corrosion)	Battery Rack Inspection Program	Battery Racks are not explicitly identified in GALL as a structural component type. VCSNS uses a Battery Rack Inspection Program (**Appendix B.1.14**) to inspect for corrosion or other physical damage to ensure integrity, thus providing acceptable aging management. This is a plant specific program which is not addressed in the GALL.
2	Caissons (Foundations)	Concrete	Below Grade	None	Not Applicable	Reinforced Concrete Caissons are used to support the foundations of the Intermediate, Diesel Generator, and Fuel Handling

Table 3.5-2:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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
2 (cont.)						Buildings at VCSNS. Concrete Caissons are inaccessible since they are completely surrounded by backfill (beneath the structure foundations) and embedded in underlying bedrock. Aging management programs are not required since the below grade environment is considered to be non-aggressive. Periodic monitoring of the below grade water chemistry will be conducted during the period of extended operation to demonstrate that the below-grade environment is not

Table 3.5-2:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS
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
2 (cont.)						aggressive. Settlement is not considered significant since the caissons are structurally embedded within the underlying bed-rock.
3	Flood Barri-ers	Elastomers	Internal, Exter-nal (Below Grade)	Cracking, Change in Material Prop-erty	Fire Protection Program, Mainte-nance Rule Struc-tures Program	The VCSNS Flood Barrier Inspection Program (**Appendix B.1.17**) is not evaluated in the GALL and is plant specific. Flood bar-rier inspections are per-formed as part of the Fire Protection Program (**Appendix B.1.5**) and Maintenance Rule Struc-tures Program (**Appendix B.1.18**).

Table 3.5-2:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS
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
4	Lubrite Plates (Class 1 Pipe Hanger Supports)	Lubricant	Internal	None	Not Applicable	Lubrite plates have been used in a few Class 1 pipe hanger supports at VCSNS. Lubrite plates are not used in the reactor pressure vessel support shoes as described in the GALL. Lubrite materials for nuclear applications are designed to resist deformation, have a low coefficient of friction, resist softening at elevated temperatures, resist corrosion, withstand high intensities of radiation, and will not score or mar; therefore, they are not susceptible to aging effects requiring management.

Table 3.5-2:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS
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
5	Pressure Doors	Carbon Steel	Internal, External	Loss of Material (General Corrosion)	Pressure Door Inspection Program, Fire Protection Program	The VCSNS Pressure Door Inspection Program (**Appendix B.1.20**) is not evaluated in the GALL and is plant specific. Pressure door inspections are performed as part of the Pressure Door Inspection and Fire Protection Programs.
6	RHR and Spray Isolation Chamber Valve Guard Pipes	Carbon Steel	Below Grade	Loss of Material (Microbiologically Induced Corrosion [MIC])	Containment ISI Program – IWE/ IWL	VCSNS has identified MIC as an aging effect requiring management for these component types. MIC has not been evaluated within the GALL. The Containment ISI Program (IWE) was effective in identification of this aging effect and

Table 3.5-2:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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
6 (cont.)						will be used in the future to provide acceptable aging management.
7	Service Water Intake Structure (SWIS)	Concrete	Raw Water (Flowing)	Loss of Material (Abrasion, Cavitation)	Underwater Inspection Program (SWIS & SWPH)	Underwater inspections are not evaluated in the GALL. VCSNS has a plant specific Underwater Inspection Program (SWIS and SWPH) (**Appendix B.1.23**) as part of the CLB which monitors the SWIS for settlement cracking, abrasion and cavitation. These underwater visual inspections are conducted every 5 years and provide for acceptable aging management.

Table 3.5-2:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS
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
8	Service Water Pump-house (SWPH)	Carbon Steel	Raw Water	Loss of Material (General Corro-sion, Pitting, MIC)	Maintenance Rule Structures Pro-gram, Underwater Inspection Pro-gram (SWIS & SWPH)	For Water-Control Struc-tures, the GALL only identi-fies corrosion as an aging mechanism and identifies RG 1.127 (XI.S7) as the acceptable AMP. VCSNS has identified additional aging effects for this com-ponent type and material, and uses the Maintenance Rule Structures Program (**Appendix B.1.18**) and Underwater Inspection Pro-gram (SWIS and SWPH) (**Appendix B.1.23**) as the primary AMPs for accept-able aging management. VCSNS uses the RG 1.127 Service Water Pond Dam

Table 3.5-2:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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
8 (cont.)						Inspection Program (**Appendix B.1.21**) inspections only for supplementary review.
9	Service Water Pumphouse (SWPH), Service Water Intake Structure (SWIS)	Concrete	Raw Water Earthen Backfill	Cracking (Settlement)	Maintenance Rule Structures Program, Underwater Inspection Program (SWIS & SWPH), Service Water Structures Survey Monitoring Program.	For Water-Control Structures, the GALL identifies RG 1.127 (XI.S7) as the acceptable AMP. VCSNS uses the Maintenance Rule Structures P[illegible] (**Appendix B.[illegible]**), Underwater Inspection Program (SWIS and SWPH) (**Appendix B.1.23**) and Service Water Structures Survey Monitoring Program (**Appendix B.1.22**) as the primary AMPs for acceptable aging

Table 3.5-2:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR STATION CONTAINMENT, OTHER STRUCTURES AND COMPONENT SUPPORTS 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
9 (cont.)						management. VCSNS uses the RG 1.127 Service Water Pond Dam Inspection Program (**Appendix B.1.21**) inspections only for supplementary review.
10	Service Water Pond Dams, North Berm	Earthen	External	Loss of Material (Erosion, seepage, piping); Cracking (Settlement)	Service Water Pond Dam Inspection Program (RG 1.127), Maintenance Rule Structures Program	For Water-Control Structures, the GALL identifies RG 1.127 (XI.S7) as the acceptable AMP. VCSNS uses the Maintenance Rule Structures Program (**Appendix B.1.18**) to supplement the RG 1.127 Service Water Pond Dam Inspection Program (**Appendix B.1.21**) inspections for acceptable aging management.

3.5.4 REFERENCES

3.5-1	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.
3.5-2	NUREG-1801, "Generic Aging Lessons Learned Report," Volumes 1 and 2, NRC, April 2001.
3.5-3	NUREG-1800, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants," NRC, April 2001.

3.6 AGING MANAGEMENT OF ELECTRICAL AND INSTRUMENTATION AND CONTROLS

3.6.1 ELECTRIC DESCRIPTION

VCSNS has performed an aging management review on the following electrical/I&C commodity groups:

- Non-EQ Insulated Cables
- Non-EQ Connectors
- Non-EQ Splices
- Non-EQ Electrical Penetration Assemblies
- Non-EQ Terminal Blocks
- High Voltage Electrical Switchyard Bus
- High Voltage Transmission Conductors and Connections
- High Voltage Insulators

3.6.1.1 Non-EQ Insulated Cables

Non-EQ insulated cables include power cables, control cables, and instrument cables. For VCSNS, these applications are defined to be at the following voltage levels:

- Low Voltage Cables: 480 VAC, 240/120 VAC, 125 VDC (and less)
- Medium Voltage Cables: 7.2 kV
- High Voltage Cables: Greater Than 7.2 kV (none in scope)

In order to facilitate the review of the cables at VCSNS, the cables are placed into two categories: (1) power cable and (2) I&C cable. The power cable category includes all 7.2 kV cables and the 480 VAC power cables. The I&C category includes the 480 VAC control cable, all 240/120 VAC cable, and all DC cables (125 VDC and less). Depending upon their application, cables utilized as switchboard wire are placed into one of these two categories, typically as I&C cable. It should be noted at this time that VCSNS purchased nearly all of its electric power cable, control cable, and instrument cable (with the exception of certain communication cables, cables ordered for specific non-safety applications, and special cables ordered subsequently for specific modifications) to 10CFR50.49 Harsh EQ standards.

The worst case cable insulation possible in application used in license renewal is polyethylene with a 60 year service limiting temperature of 131°F. The non-EQ insulated cables will be subject to an aging management program as described in **Table 3.6.1**.

3.6.1.2 Non-EQ Electrical Connectors

Cable connections are used to connect the cable conductors with other cables or with a variety of electrical devices (e.g., instruments, motors, etc.). The various types of insulated cable connections (or terminations) are identified in the Cable Aging Management Guideline (AMG) [Section 3.3.2 of **Reference 3.6-1**]. The Cable AMG describes the cable termination grouping as follows:

- Compression connectors
- Fusion connectors
- Plug-in / Multi-pin connectors

A variety of plant documents were reviewed to identify electrical connectors in use at VCSNS, including procurement records, plant drawings, EQ binders, and plant maintenance documents. This review provided strong reasonable assurance that all types of connectors have been identified and that the bounding materials for the connectors at VCSNS have also been identified. Connectors are included in the Non-EQ Insulated Cables and Connections Inspection Program.

3.6.1.3 Non-EQ Electrical Splices

Many of the splices at VCSNS are delineated in a calculation which identifies all safety-related (Class 1E) 7.2 kV and 480V splices in the plant. The BOM table for the electric cables lists common splice and tape materials ordered for VCSNS during plant construction. The identification of VCSNS splices included a review of EQ documentation, procurement records, and design basis documents. This review provided strong reasonable assurance that all splice types and materials applicable to VCSNS (which may be subject to aging management review) have been identified. Non-EQ splices are included in the Non-EQ Insulated Cables and Connections Inspection Program.

3.6.1.4 Non-EQ Electrical Penetration Assemblies

Electrical penetration assemblies are utilized to carry electrical circuits through the Reactor Building containment wall while maintaining pressure-tight integrity. They provide the electrical continuity of the circuit and the pressure boundary for containment integrity. The scope of the review in this report applies only to the electrical function of the penetration assemblies. The pressure-retaining function of the penetration assemblies is addressed in **Section 2.4** of this application for the Reactor Building.

All the electrical penetrations at VCSNS have been listed in the VCSNS EQ program, whether or not they carry Class 1E circuits. The non-Class 1E electrical penetrations are classified as category "B1, B2" components with respect to EQ (i.e., they must not fail and

prevent the accomplishment of a NSR function) and are administratively included in the EQ program in order to credit the portion of the EQ testing which justifies the pressure-retaining function of the penetrations. VCSNS utilizes D.G. O'Brien electrical penetration for its non-Class 1E applications.

The D.G. O'Brien electrical penetration assemblies are subject to aging management review. This review provides for their identification and also for the listing of the organic materials found during the review. Because there are D.G. O'Brien electrical penetration assemblies that are part of the VCSNS EQ program and have been evaluated in detail for that purpose, there is reasonable assurance that all their organic materials have been identified and properly evaluated with respect to aging for the non-EQ installations. An additional review has shown Non-EQ Electrical Penetrations at VCSNS to be located in areas inside and outside of the RB which have less severe environments, that are clearly enveloped by material properties and aging testing and evaluation done through the manufacturer. The Non-EQ Electrical Penetrations at VCSNS are not included in the Non-EQ Insulated Cables and Connections Inspection Program. The evaluation of the Non-EQ Electrical Penetrations at VCSNS is further documented in **Table 3.6-2 Item 2**.

3.6.1.5 Non-EQ Terminal Blocks

A terminal block consists of an insulating base with fixed metallic points for landing wires (conductors) or for connecting terminal rings (lugs). Terminal blocks are typically installed in an enclosure such as a control board, MCC, motor, terminal box, or a panel.

A complete list of the specific terminal blocks used at VCSNS does not exist in one file or location; however, a review of the Bills of Material and other plant documents (EQ files, etc.) for general electrical equipment revealed that the following suppliers have terminal blocks in use at VCSNS: GE, Kulka, Marathon, States, and Weidmuller.

From the Cable AMG [**Reference 3.6-1**], the most common materials used in the insulating base are phenolic, melamine resin, and nylon. The material with the least thermal and radiation resistance is nylon. Because there is no single document that lists all terminal block manufacturers, materials, and locations for VCSNS, nylon was chosen as the bounding material for the evaluation of the terminal blocks, due to its limited radiation resistance. By choosing nylon as the limiting material with respect to the plant environmental conditions, there is reasonable assurance that the terminal blocks at VCSNS are properly evaluated with respect to aging. Non-EQ terminal blocks are included, as appropriate, in the Non-EQ Insulated Cables and Connections Inspection Program.

3.6.1.6 High Voltage Electrical Switchyard Bus

High Voltage (HV) electrical switchyard bus is uninsulated, unenclosed, rigid electrical conductor used in switchyards and switching stations to connect two or more elements of an electrical power circuit such as active disconnect switches and passive transmission conductors. The review of switchyard bus included the bus itself as well as the hardware used to secure the bus to high-voltage insulators.The in scope switchyard bus at VCSNS is constructed of aluminum tubing or copper rods, and supported on station post insulators with aluminum cast fastening hardware.

For the ambient environmental conditions at VCSNS, no significant aging effects have been identified that would cause a loss of function for the extended period of operation. The potential effects of surface oxidation and vibration are not considered significant for the VCSNS installation. No aging management program for HV electrical switchyard bus is required.

3.6.1.7 High Voltage Transmission Conductors and Connections

Transmission conductors are uninsulated, stranded electrical cables used in switchyards, switching stations and transmission lines to connect two or more elements of an electrical power circuit such as active disconnect switches, power circuit breakers and transformers to passive switchyard bus. The review of transmission conductors included the transmission conductors and the hardware used to secure the conductors to a high-voltage insulator or to switchyard bus. Transmission conductors are supported by passive high-voltage strain or suspension insulators. Transmission conductors and connection hardware at VCSNS are made of aluminum reinforced with galvanized steel.

For the ambient environmental conditions at VCSNS, no significant aging effects related to conductor corrosion or wind loading vibration or sway on connections have been identified that would cause a loss of function for the extended period of operation. No aging management program for HV transmission conductors and connections is required.

3.6.1.8 High Voltage Insulators

HV switchyard post insulators and strain or suspension insulators as typically used on transmission towers are insulating materials in a form designed to (a) support a conductor physically and (b) separate the conductor electrically from another conductor or object. The insulators evaluated for license renewal are those used to support and insulate high voltage electrical components in switchyards, switching stations and transmissions such as transmission conductors and switchyard bus. HV insulators serve as an intermediate support between a supporting structure (such as a transmission tower or support pedestal) and the

switchyard bus or transmission conductor. Materials of construction include porcelain, metal (insulator cap and pin) and cement to join the cap or pins to the porcelain.

For the ambient environmental conditions at VCSNS, no significant aging effects related to airborne contaminants or mechanical wear have been identified that would cause a loss of function for the extended period of operation. No aging management program for HV insulators is required.

3.6.2 AGING MANAGEMENT REVIEW

3.6.2.1 Methodology

The AMR methodology for the electrical discipline for VCSNS is summarized in the following points:

- Evaluation of the electrical component commodity groups (subject to AMR) to identify the organic materials subject to age-related degradation
- Identification and evaluation of the 60-year service-limiting environmental parameters for these organic materials
- Identification and evaluation of the aging mechanisms and effects to determine which require review
- Identification and evaluation of the service conditions (i.e., the operating environments and locations) for the electrical component commodity groups
- Evaluation of the industry and plant-specific operating experience for the electrical component commodity groups
- Aging management program evaluation (following NUREG-1801)
- Demonstration of aging management

The review of the VCSNS electrical component commodity groups with respect to aging mechanisms and effects was performed based upon the guidance of various industry documents, primarily SAND96-0344, *Aging Management Guideline for Commercial Nuclear Power Plants – Electrical Cable and Terminations* **[Reference 3.6-1]**. This document provides detailed materials analysis for cable and termination materials exposed to nuclear power plant environments. It also provides guidance for performing aging management reviews pursuant to 10 CFR 54.

The methodology used for the aging management review of the electrical commodity groups employs the "Plant Spaces" approach in which the plant is segregated into areas (or spaces) where common bounding environmental parameters can be assigned. The VCSNS plant operating environments are delineated as "Environmental Zones." Each bounding environ-

mental zone is evaluated against the material of the commodity groups most susceptible to aging to determine if the components will be able to maintain their intended function through the period of extended operation. With respect to the electrical components, the environmental parameters of interest are temperature, radiation and moisture.

The intended functions of the electrical component commodity groups under review are as follows:

- To electrically connect or insulate two sections of an electrical circuit and/or to provide for continuity or insulation of electrical circuits.
- The electrical penetration assemblies also have a structural function to provide a leak-tight barrier for containment isolation; this is evaluated in **Section 2.4.1.3** of this application.

3.6.2.2 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) 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 Section 3.6.2.1.

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

3.6.3 AGING MANAGEMENT PROGRAM

3.6.3.1 Aging Management Programs Evaluated In NUREG-1801 That Are Relied On For License Renewal

Table 3.6.1 shows the aging management groups (combinations of components, materials and aging effects) and the aging management programs evaluated in NUREG-1801 that are relied on for license renewal of the electrical and instrumentation and control components at VCSNS. Note that this table only includes those components, materials and aging effects that are applicable to a PWR. The VCSNS comparison to NUREG-1801 (including clarifications and exceptions) is included in the "Discussion" column.

3.6.3.2 Further Evaluation Of Aging Management As Recommended By NUREG-1801

Further evaluation of aging management as recommended by the NUREG-1801 has been incorporated into the "Discussion" column of Table 3.6-1.

Table 3.6-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR ELECTRICAL AND INSTRUMENTATION AND CONTROL COMPONENTS 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	Electrical equipment subject to 10 CFR 50.49 environmental qualification (EQ) requirements	Degradation due to various aging mechanisms	Environmental Qualification of Electrical equipment	Yes, TLAA	The TLAA for electrical equipment in the EQ Program is discussed in **Section 4.4** of this application.
2	Electrical cables and connections not subject to 10 CFR 50.49 EQ requirements	Embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced insulation resistance (IR); electrical failure caused by	Aging management program for electrical cables and connections not subject to 10 CFR 50.49 EQ requirements	No	VCSNS applies the Non-EQ Insulated Cables and Connections Inspection Program (**Appendix B.2.9**) to these cables and connections even though the environmental conditions within the plant are not severe enough to show that the aging effects associated with elevated temperature are significant for the cable and connector/termination insulation materials.

Table 3.6-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR ELECTRICAL AND INSTRUMENTATION AND CONTROL COMPONENTS 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
2 (cont.)		thermal/thermoxidative degradation of organics; radiolysis and photolysis (ultraviolet [UV] sensitive materials only) of organics; radiation-induced oxidation; moisture intrusion			
3	Electrical cables used in instrumentation circuits not subject to 10 CFR 50.49 EQ	Embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced IR;	Aging management program for Electrical Cables and Connections not subject to 10 CFR 50.49 EQ requirements	No	VCSNS applies the Non-EQ Insulated Cables and Connections Inspection Program (**Appendix B.2.9**) to these cables and connections even though the environmental conditions within the plant are not severe enough to show that the aging effects associated with elevated temperature are significant for the

Table 3.6-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR ELECTRICAL AND INSTRUMENTATION AND CONTROL COMPONENTS 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.)	requirements that are sensitive to reduction in conductor insulation resistance	electrical failure caused by thermal/ thermoxidative degradation of organics; radiation-induced oxidation; moisture intrusion			insulation materials. Additional information is provided in **Table 3.6-2 Item 1**.
4	Inaccessible medium-voltage (2kV to 15kV) cables (e.g., installed in conduit or direct buried) not subject to 10 CFR	Formation of water trees; localized damage leading to electrical failure (breakdown of insulation) caused by moisture intrusion and water trees	Aging management program for inaccessible medium-voltage cables not subject to 10 CFR 50.49 EQ requirements	No	The aging management review for medium voltage cables exposed to moisture and voltage stressors concluded that aging management at VCSNS is not required. No instances of power cable failure at VCSNS due to moisture intrusion were found.

Table 3.6-1:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR ELECTRICAL AND INSTRUMENTATION AND CONTROL COMPONENTS 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
4 (cont.)	50.49 EQ requirements				
5	Electrical connectors not subject to 10 CFR 50.49 EQ requirements that are exposed to borated water leakage	Corrosion of connector contact surfaces caused by intrusion of borated water	Boric acid corrosion	No	With regard to NUREG-1801 Chapter VI item A.2.1, the aging management for electrical connectors which may experience boric acid corrosion will be addressed by the Boric Acid Corrosion Surveillance (**Appendix B.1.2**) program at VCSNS. A separate electrical program will not be developed. The procedures which comprise the VCSNS Boric Acid Corrosion Surveillance program are sufficient to address the NUREG-1801 standard.

3.6.3.3 Aging Management Evaluations That Are Different From Or Not Addressed In NUREG-1801

Table 3.6-2 contains electrical and instrument and control components aging management review results that are not specifically addressed in NUREG-1801. This table includes component types, materials, environments and aging effects requiring management, along with the programs and activities for managing aging.

Table 3.6-2:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR ELECTRICAL AND INSTRUMENTATION AND CONTROL COMPONENTS 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	Electrical cables used in instrumentation circuits not subject to 10 CFR 50.49 EQ requirements that are sensitive to reduction in conductor insulation resistance	Various organic insulating materials.	Maximum ambient temperature potential is 131°F Maximum 60 year gamma radiation potential is 1.95E10 Rads	Embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced IR; electrical failure caused by thermal/thermoxidative degradation of organics; radiation induced oxidation; moisture intrusion.	Non-EQ Insulated Cables and Connections Inspection Program	NUREG-1801 recommends an aging management program specifically for cables with sensitive, low-level signals. VCSNS applies the Non-EQ Insulated Cables and Connections Inspection Program (**Appendix B.2.9**) (**Table 3.6-1 Item 2**). The visual inspection of instrument as well as power and control cables is considered a better means to identify age-related degradation due to localized ambient thermally and radiologically induced stress prior to significant

Table 3.6-2:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR ELECTRICAL AND INSTRUMENTATION AND CONTROL COMPONENTS 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 (cont.)						loss of insulation resistance.
2	Non-EQ Electrical Penetration Assemblies	Polysulfone insulation, Silicon Rubber o-rings, Fiberglass epoxy, Neoprene gaskets, Molycote thread sealant, Polycarbonate view port.	Maximum ambient temperature is 121°F for a short time in Env. Zones PAA-03 and PAI-02. Maximum 60 year gamma radiation is 3.0E06 Rads in Env. Zone RB-05.	Embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced insulation resistance; electrical failure caused by thermal/Thermoxidative degradation of organics; radiolysis and photolysis (ultraviolet sensitive materials only) of	None required.	Non-EQ Electrical Penetrations at VCSNS are located in areas inside and outside of the RB in environments which are clearly enveloped by material properties and aging testing and evaluation done through the manufacturer. Cable that utilize these penetrations are addressed in **Table 3.6-1 Item 2**.

Table 3.6-2:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR ELECTRICAL AND INSTRUMENTATION AND CONTROL COMPONENTS 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
2 (cont.)				organics; radiation-induced oxidation; moisture intrusion		
3	Electrical Switchyard Bus	Aluminum, copper	Outdoor environment in air and rainwater	Change in material properties leading to increased resistance and heating due to oxidation. Also cracking due to vibration.	None	For the ambient environmental conditions at VCSNS, no aging effects have been identified that could cause a loss of function. No aging management is required.
4	High Voltage Transmission Conductors and	Aluminum, Steel	Outdoor environment in air and rainwater	Loss of conductor strength due to corrosion. Also wear or fatigue	None	For the ambient environmental condition at VCSNS, no significant aging effects related to corrosion or wind

Table 3.6-2:
SUMMARY OF AGING MANAGEMENT PROGRAMS FOR ELECTRICAL AND INSTRUMENTATION AND CONTROL COMPONENTS 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
4 (cont.)	Connections	Aluminum, Steel	Outdoor environment in air and rainwater	due to wind loading vibration or sway.		loading vibration or sway for conductors or connections have been identified that could cause a loss of function. No aging management program is required.
5	High Voltage Insulators	Porcelain, metal cap or pin, cement	Outdoor environment in air and rainwater	Surface contamination or cracking due to airborne contaminants. Also loss of material due to mechanical wear.	None	For the ambient environmental conditions at VCSNS, no significant aging effects related to airborne contaminants or mechanical wear have been identified that could cause a loss of function. No aging management program is required.

3.6.4 REFERENCES

3.6-1	U. S. Department of Energy Report SAND 96-0344, Aging Management Guideline for Commercial Nuclear Power Plants - Electrical Cable and Terminations, September 1996.