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Document Control Desk
U. S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Sir / Madam:

Subject: VIRGIL C. SUMMER NUCLEAR STATION
DOCKET NO. 50/395
OPERATING LICENSE NO. NPF-12
RESPONSES TO REQUESTS FOR ADDITIONAL INFORMATION (RAI) FOR THE REVIEW OF THE LICENSE RENEWAL APPLICATION FOR VIRGIL C SUMMER NUCLEAR STATION

Attachments:
I. Refined 10 CFR 54.4(a)(2) Criteria Questions From 09/15/2003
II. Area Based Inspections for Refined 10 CFR 54.4(a)(2) Criteria Questions From 09/17/2003
III. Revisions to FSAR After 09/02/2003
IV. Additional Staff Questions

In Attachments I, II and IV you will find responses to the Requests for Additional Information (RAIs) regarding the License Renewal Application for the Virgil C. Summer Nuclear Station (VCSNS). Attachment III contains pertinent sections of the FSAR Supplement, Chapter 18, which are revised as a result of issues identified by the NRC Staff and from the AMR Inspections conducted during the weeks of August 4 and 18, 2003.

Please contact Al Paglia at (803) 345-4191 if you have additional questions or comments.

I certify under penalty of perjury that the foregoing is true and correct.

9/24/03
Executed on

Stephen A. Byrne
Senior Vice President, Nuclear Operations

A094

AMP/SAB/dr
Attachments (4)

c: N. O. Lorick (w/o attachment)
N. S. Carns (w/o attachment)
T. G. Eppink (w/o attachment)
R. J. White
R. B. Clary
L. A. Reyes
K. R. Cotton (w/o attachment)
NRC Resident Inspector
R. C. Auluck
T. B. Doerr (w/o attachment)
T. P. O'Kelley
P. Ledbetter (w/o attachment)
K. M. Sutton
NSRC
File (821.00)
DMS (RC-03-0208)

Attachment I

Refined 10 CFR 54.4(a)(2) Criteria Questions From 09/15/2003

RAI S AMR-1

In Table 1 of the document "Criteria 2 Supplement to the Application for Renewed Operating License for VCSNS" submitted by VCSNS on September12, 2002, the applicant maintained that for a number of component/material/environment combinations there is no applicable aging effect and therefore there is no applicable aging management program(s). The Staff has reviewed the related information and the basis provided by the applicant for this conclusion. The Staff has found that in order to complete the review of the aging management review (AMR) in "Criteria 2 Supplement to the Application for Renewed Operating License for VCSNS" additional information is needed from the applicant. This is related to Items #6, #7, and #11 of Table 1.

a. In Item #6 of Table 1 (p. 21) in "Criteria 2 Supplement to the Application for Renewed Operating License for VCSNS" under the 'Discussion' column the applicant stated that "this grouping (referring to component type listed in item #6) also includes the internal surface of system components that contain non-dried air. These components may experience internal surface corrosion but they are not expected to have a loss of structural integrity." Provide the basis for this conclusion, including any operating experience. In particular clarify whether any of the said components has any intended function that is other than structural integrity.

   In addition, the staff notes that the piping and piping system components in Item #6 is a subset of those of Item # 4. For this subset both items have consistent components, materials and environment (other than external versus internal). The corresponding AMR (for non-dried air in #6 or moist air in #4) leads to different conclusions for components in the two items (#4 and #6) regarding the need for aging management. Provide the basis for the different AMR conclusions and verify the consistency with the applicant's response to the clarification on the intended function of the components.

b. In Item #7 of Table 1 (p. 22) in "Criteria 2 Supplement to the Application for Renewed Operating License for VCSNS" under the 'Discussion' column, the applicant stated that raw water is part of uncontrolled water. Loss of material due to MIC and erosion in the raw water environment are not considered as applicable aging effects/mechanisms for the components in item #7. However, for a combination of components types/materials/ environments in item #11 (p. 24) that is consistent with that of item #7 loss of material due MIC and erosion are considered to be applicable aging effects/mechanisms for a raw water environment. Provide the basis for this difference in the AMR, including if applicable, operating experience.

For the aging management of the components considered in Item #11 the applicant proposed the AMP Service Water Reliability and In-Service Testing (B.1.9). For Item #7 the applicant proposed the AMP Area-Based Inspections for Refined 10 CFR 54.4(A)(2) Criteria (B. 2.13). The applicant stated in Appendix B of the VCSNS LRA that B.1.9 is consistent with GALL AMP Open-Cycle Cooling Water System (XI.M20). The GALL AMP XI.M20 involves periodic inspections. The applicant's AMP B. 2.13 uses one-time inspection. For the part of the combination of piping and piping system/carbon steel/raw water that is consistent for both Items #7 and #11, provide the basis, including any applicable operating experience that periodic inspections are necessary to manage the aging effects for Item # 11, whereas one-time inspection is sufficient for the aging management for Item #7.

c. In the discussion column of Item # 16 of Table 1 (p. 26) in "Criteria 2 Supplement to the Application for Renewed Operating License for VCSNS", the applicant stated that this grouping included fiberglass piping insulation exposed to a moist air environment. The applicant further maintained that at VCSNS, the ambient environment did not contain contaminants of sufficient concentration to cause aging effects that require aging management. However, moisture infiltration into the fiberglass insulation materials may, over time. lead to compression or settling of the fiberglass material. This may in turn lead to a reduction of the insulating properties of the fiberglass. As a result, a different temperature distribution may arise across the layer of fiberglass insulation material with a possibly lower temperature at the piping/insulation interface. This may increase the likelihood of further moisture condensation and consequently surface corrosion of the piping materials. Clarify whether this aging effect is applicable to the fiberglass piping insulation material for VCSNS and provide a basis, including operating experience for the clarification.

Fiberglass insulation material often has accompanying metal-foil based (such as aluminum) vapor retarder component. Clarify whether this is the case for the insulation material used at VCSNS. If so, some parts of these metal-foil based vapor retarder components may be in contact with the metallic surface (such as carbon steel) of other, different uninsulated piping close by (not the original host piping which is insulated) due to close spatial interaction. In the presence of moisture this may give rise to galvanic corrosion. Clarify whether loss of material due to galvanic corrosion is an applicable aging effect at VCSNS arising from the process described above and provide a basis, including operating experience for the clarification.

Response to RAI S AMR-1 a:

All items in the Criteria 2 Supplement were included due to their potential interaction with safety related SSCs. Specifically, the functional requirement is to maintain structural integrity. A few of these components which are located over sensitive components, such as electrical switchgear or motor control centers, must not leak fluid. VCSNS took a conservative approach to Criteria 2 and included in scope all piping in the

areas of seismic concern unless specifically evaluated out. VCSNS also credited existing programs for aging management of added components.

The environments included in Table 1, Item 6, are not wet. Piping that is subject to internal wetting and thus a potential source of spray or drips is included in item 7, not Item 6. Table 1, Item 6, includes the interior of non-fluid containing carbon steel piping components. The environments include dried air, process gasses (like nitrogen), non-dried compressed air (service air, SA), condenser vacuum pump exhaust and connections for Main Steam (air removal, AR), and non-dried air from inside the plant (DG, HR, and LR). None of these environments are considered "aggressive" and none of these system pressure boundaries are required for license renewal. Significant internal corrosion is not expected for these applications, structural integrity will be maintained, and the (non-required) pressure boundary will be maintained. Neither VCSNS nor the industry have had any operating experience to indicate that loss of structural integrity is a concern for these material environment combinations

Table 1, Item 4, is the external environment of carbon steel piping systems. VCSNS conservatively included Item 4 piping within the scope of the Inspections for Mechanical Components. Inspections for Mechanical Components is an inspection activity that will manage loss of material due to general and/or galvanic corrosion on the external surface of susceptible materials such as carbon and low alloy steel. The activity involves the visual examination of the exposed external surfaces of mechanical components in areas of the plant containing components/component types in the scope of license renewal. The external surfaces of components should be dry and not subject to any significant corrosion; however, condensation, drips, spray, leakage, and other external conditions may lead to aging that could require management. Provisions for removal of insulation to permit visual inspection are provided for selected components. This program will identify visible aging effects and utilize the Corrective Action Program to determine the extent and source of the degradation and effect repairs and identify additional actions.

For piping components containing air and gasses (Table 1, Item 6), drips or spray on the internal surface are not postulated. Condensation may occur in AR piping; however, its effect is limited to corrosion on the bottom of the pipe. Even if a through wall failure were to occur, it will not lead to a structural failure and the Inspections for Mechanical Components program will detect the through wall leak and the pipe will thus be repaired.

The VCSNS position on Criteria 2 components is conservative when compared to the Staff position presented in the enclosure to Staff Position Letter from C. I. Grimes (NRC) to A. Nelson (NEI) and D. Lochbaum (UCS), subject "License Renewal Issue: Guidance On The Identification And Treatment Of Structures, Systems, And Components Which Meet 10 CFR 54.4(a)(2)", dated March 15, 2002. VCSNS has included all piping, ductwork, and insulation contained in seismic areas of the plant in scope unless it was specifically evaluated out. Although pressure boundary is not normally required,

programs that manage pressure boundaries perform aging management of most components added by the Supplement.

Response to RAI S AMR-1 b:

Table 1, Item 7, includes piping environment resulting from uncontrolled sources such as rainwater, leaking ground water and water drained from equipment. For this discussion rainwater is not considered raw water. These systems are not subject to erosion based on design and operating conditions. Drain lines have very low flow rates; and safety and relief valves have very limited operating time at design flow rates.

Piping on the discharge of the Non-Nuclear Plant Drains (MD) sump pumps is exposed to raw water when equipment is drained or from other sources. The sump pump discharge piping is the only piping in Item 7 that is normally filled. Leakage from the sump pump discharge piping is not a concern for license renewal. MIC induced leakage will be detected and appropriate corrective action taken before the loss of structural integrity. Other MD piping is normally dry or partially wetted by drainage from non-raw water sources, such as condensate from air handling units or rain. Systems other than MD, included in Item 7, are not exposed to raw water.

Area Based Inspections for Refined 10 CFR 54.4(a)(2) Criteria is a new one-time inspection that will detect and characterize loss of material due to general, crevice, and pitting corrosion resulting from exposure to an unmonitored and uncontrolled water environment. If MIC is present it will also be detected. Area Based Inspections for Refined 10 CFR 54.4(a)(2) Criteria was added to manage aging for those components that were not suitable for inclusion into a program identified in the Application. The aging mechanisms are not expected to challenge the structural integrity of these piping systems; therefore, a one-time inspection approach is applied to confirm this conclusion. For those drain lines over sensitive components a one-time inspection will be performed to predict the potential for through wall leakage occurring during the 60-year plant life. The inspections will determine if corrective actions such as future inspections or repair will be required.

Aging management, from the Inspections for Mechanical Components program, is applicable for the exterior of these components. Leakage in drain lines or the MD sump pump discharge (due to degradation from aging mechanisms such as crevice corrosion, pitting corrosion and MIC) would lead to detectable external leakage prior to a loss of structural integrity.

Table 1, Item 11, is applicable to Service Water (SW). SW is in scope as a safety related system where pressure boundary is required for license renewal. The specific program for SW is an existing program.

Response to RAI S AMR-1 c:

Table 1, Item 16, includes fiberglass insulation on both stainless steel and carbon steel piping and ductwork. Fiberglass insulation is used outside the Reactor Building. Insulation is included in the scope of license renewal for potential interaction (Criteria 2) only. The insulating properties of insulation are not a license renewal intended function.

The structural aspects of plant design (protective/mitigative features) that preclude an adverse impact on nuclear safety-related components due to flooding are also in the scope of license renewal. Outside the Reactor Building, blockage of sumps does not adversely impact the plant flooding evaluations.

Three (3) types of insulation are used inside the reactor building: stainless steel reflective insulation and two types of mass insulation encapsulated in stainless steel. The stainless steel reflective insulation is used primarily on piping. One type of mass insulation encapsulated in stainless steel is used only around the reactor pressure vessel loop inlet and outlet nozzles and the portions of reactor coolant piping that penetrate the primary shield wall. The other type of mass insulation encapsulated in stainless steel is used on the pressurizer and steam generator level and flow instrument tubing. Insulation within the Reactor Building is included in Table 1, Item 5. More detail on Reactor Building insulation can be found in FSAR Section 6.3.2.6.1.

Inspections for Mechanical Components program is an inspection activity that will manage loss of material due to general and/or galvanic corrosion on the external surface of susceptible materials such as carbon and low alloy steel. This program will manage the effects of condensate leaking from insulation onto carbon steel. The activity involves the visual examination of the exposed external surfaces of mechanical components in areas of the plant containing components/component types in the scope of license renewal. This program will identify visible aging effects and utilize the Corrective Action Program to effect repairs and identify additional actions.

Attachment II

Area Based Inspections for Refined 10 CFR 54.4(a)(2) Criteria Questions From 09/17/2003

RAI B.2.13-1

a. In the element "Detection of Aging Effect(s)" the applicant stated that the AMP will use a combination of volumetric and visual examination techniques at sample locations in the drain lines determined by engineering evaluation to be most susceptible to the applicable aging effects. The applicant further maintained that, if no parameters are known that would distinguish the susceptible locations, sample locations will be selected based on accessibility and radiological concerns, and the results will be applied to the associated piping. In the case when no one single bounding location can be determined, clarify whether more than one sample location (i.e., several of them, if necessary) for the same associated piping would be chosen. Provide the basis for the clarification. From the description it appears that only drain lines are subject to examination. Clarify if sample locations include safety and relief valve discharge piping. Verify that inspection is of internal surfaces and clarify how visual inspection will be performed on internal surfaces. Is safety and relief valve discharge piping susceptible to erosion and if so how is this managed? If not susceptible to erosion, provide the basis. Clarify which systems are exposed to leaking ground water and how MIC is managed for these systems.

b. The Staff notes that the applicant maintained that the acceptance criteria for the Area Based Inspections for Refined 10 CFR 54.4(a)(2) Criteria is no unacceptable loss of material of subject components that could result in a loss of the component intended function(s), as determined by engineering evaluation. In the attribute "Corrective Actions", the applicant stated that if the engineering evaluation determines that additional information is required to more fully characterize the aging effects, then additional inspections will be completed or other actions taken in order to obtain the additional information. If additional inspections were undertaken, clarify whether evaluation of the inspection results will consider the present wall thickness, calculated corrosion rate, and projected wall thickness that will ensure that the minimum required wall thickness is preserved pursuant to the maintenance of the intended function of these components. Provide the basis, including available industry operating experience for the clarification.

c. The Operating Experience element states that the Area Based Inspections for Refined 10 CFR 54.4(a)(2) Criteria is a new inspection activity for which there is no operating experience. Identify any relevant operating experience, both site-specific and industry-wide, for the systems that will be managed by this program. Confirm that operating

experience review includes plant operating and maintenance history for the systems managed by this program, as required by section 4.2.2.2 of NEI 95-10.

Response to RAI B.2.13-1 a:

Area Based Inspections for Refined 10 CFR 54.4(a)(2) Criteria is the aging management program for the components identified in the Criteria 2 Supplement, Table 1, Item 7, which includes the piping environment resulting from uncontrolled sources such as rainwater, leaking ground water and water drained from equipment. (For this discussion, rainwater is not considered raw water.)

The piping included is:

- **Main Steam Dump (MB) discharge lines for the atmospheric dump valves**
- **Non-Nuclear Plant Drains (MD) drain lines and sump pump discharge piping**
- **Main Steam (MS) discharge lines for the safety valves**
- **Roof Drains (RD)**
- **Sewer (SE) line from an abandoned restroom in the Fuel Handling Building**

These systems are not subject to erosion based on design and operating conditions. (Drain lines have very low flow rates; and safety and relief valves have very limited operating time at design flow rates.)

Piping on the discharge of the Non-Nuclear Plant Drains (MD) sump pumps is exposed to raw water either when equipment is drained or from other sources. The sump pump discharge piping is the only piping in Item 7 that is normally filled. Leakage from the sump pump discharge piping is not a concern for license renewal. MIC induced leakage will be detected and appropriate corrective action taken before the loss of structural integrity. Other MD piping is normally dry or partially wetted by drainage from non-raw water sources, such as condensate from air handling units or rain. Systems other than MD, included in Item 7, are not exposed to raw water.

Area Based Inspections for Refined 10 CFR 54.4(a)(2) Criteria is a new one-time inspection that will detect and characterize loss of material due to general, crevice, and pitting corrosion resulting from exposure to an unmonitored and uncontrolled water environment. If MIC is present, it will also be detected. Area Based Inspections for Refined 10 CFR 54.4(a)(2) Criteria was added to manage aging for those components that were not suitable for inclusion into a program identified in the Application. The aging mechanisms are not expected to challenge the structural integrity of these piping systems; therefore, a one-time inspection approach is applied to confirm this conclusion. For those drain lines over sensitive components, a one-time inspection will be performed to predict the potential for through wall leakage occurring during the 60-

year plant life. The inspection will determine if corrective actions such as future inspections or repair will be required. Inspection techniques will be selected based on accessibility and suitability and may include visual and ultrasonic methods.

Aging management, from Inspections for Mechanical Components, is applicable for the exterior of these components. Leakage in drain lines or the MD sump pump discharge (due to degradation from aging mechanisms such as crevice corrosion, pitting corrosion and MIC) would lead to detectable external leakage prior to a loss of structural integrity.

Response to RAI B.2.13-1 b:

Area Based Inspections for Refined 10 CFR 54.4(a)(2) Criteria is a new one-time inspection that will detect and characterize loss of material due to general, crevice, and pitting corrosion resulting from exposure to an unmonitored and uncontrolled water environment. If MIC is present, it will also be detected. Area Based Inspections for Refined 10 CFR 54.4(a)(2) Criteria was added to manage aging for those components that were not suitable for inclusion into a program identified in the Application. The aging mechanisms are not expected to challenge the structural integrity of these piping systems; therefore, a one-time inspection approach is applied to confirm this conclusion. For those drain lines over sensitive components, a one-time inspection will be performed to predict the potential for through wall leakage occurring during the 60-year plant life. The inspection will determine if corrective actions such as future inspections or repair will be required.

The operation experience reviews performed identified aging issues regardless of the component's license renewal intended function. The NCR's operating experience identified no new aging effects.

Response to RAI B.2.13-1 c:

A reasonable and representative dataset of VCSNS aging related operating experience was provided by Non-Conformance Notices (NCNs) documenting equipment failures during the approximate five (5) year period from January 1996 through July 2001. This NCN search was conducted comprehensively for multiple systems and disciplines in order to minimize duplication and to ensure that relevant operating experience was not omitted in the refinement process for a system or discipline specific search.

Due to the potential for aging related issues that did not result in a non-conformance, a keyword search of the Condition Evaluation Report (CER) database was also conducted

to identify relevant events. The approximate time period of August 1998 to July 2001, which begins with the site implementation of the Database, was searched.

The operating experience review identified no new aging effects requiring management associated with Criteria 2.

All Affected AMPs

a. Are there new boundary diagrams for the additional scope? If not, clarify how boundaries are conservatively determined.

b. A supplement for AMP B.2.3 has not been included in the supplemental submittal. Clarify if this AMP is affected by the change in scope and if it is affected, submit a supplemental program description. Also, if UFSAR supplements are affected by the change in scope, submit a revised UFSAR supplement for any AMP that is affected. If revised UFSAR supplements are not required, so indicate.

Response to RAI for All Affected AMPs a:

Boundary drawings were not marked for the additional scope. An area based approach with the piping and insulation treated as commodities was used.

Response to RAI for All Affected AMPs b:

No revision is required for the FSAR description provided in the Application Appendix A 18.2.21.

An evaluation of the program determined the scope presented in the Application Appendix B Section B.2.3 (1) Scope should be revised as provided below. The selected sample location described in Section B.2.3 (4) Detection of Aging Effects provides reasonable assurance that the components added by the Criteria 2 Supplement can maintain their structural integrity. Supplement added components are not required to maintain the pressure boundary integrity to meet their license renewal intended function.

(1) Scope - The Liquid Waste System Inspection is applicable to stainless steel components exposed to unmonitored and uncontrolled borated water in the following systems:

- **Leak Detection (LD)**

- **Liquid Effluents from Nuclear Plant to Penstock (LW)**
- **Non-Nuclear Plant Drains (MD)**
- **Nuclear Blowdown Processing (NB)**
- **Nuclear Plant Drains (ND) - pipe and valve bodies.**
- **Liquid Waste Processing (WL) - pipe, valve bodies and heat exchanger components**
- **Excess Liquid Waste (WX)**

The unmonitored and uncontrolled borated water environment consists of the following:

- **Contents of the Reactor Building or Incore Instrumentation Sumps being discharged through a containment penetration (ND System).**
- **Contents of the Reactor Coolant Drain Tank (RCDT) on the tube-side of the RCDT Heat Exchanger and passing through a containment penetration (WL System).**
- **Concentrates from the Waste Evaporator Package on the tube-side of the Concentrates Sample Cooler (WL System).**
- **Leakage or spills of chemicals from the Turbine Cycle Chemical Feed and/or battery acid processed by Non-Nuclear Plant Drains (MD). This piping is in scope for structural integrity only.**
- **Various waste streams in Leak Detection (LD), Liquid Effluents from Nuclear Plant to Penstock (LW), Nuclear Blowdown Processing (NB), Nuclear Plant Drains (ND), Liquid Waste Processing (WL), and Excess Liquid Waste (WX) piping that is in scope for structural integrity due to seismic interaction concerns.**

Attachment IV

Additional Staff Questions

Stress Corrosion Cracking of Incore Neutron Detector Conduits Questions From 09/16/2003

Incore neutron detector conduits credit only the Chemistry Program for aging management of stress corrosion cracking (SCC). Provide justification that the chemistry alone will provide aging management of SCC for the stainless steel conduit in close proximity to the Reactor Vessel.

Response to RAI SSC of BMI:

Stress corrosion cracking (SCC) occurs through the combination of high stress (both applied and residual tensile stresses), a corrosive environment, and a susceptible material. For a particular material, high stresses require less corrosive environments, while highly corrosive environments require less stress to initiate and propagate cracking. Elimination or reduction in any of these three factors will decrease the likelihood of SCC occurring. Dissolved oxygen, sulfates, fluorides, chlorides and temperature are contributors to a corrosive environment.

The stainless steel incore neutron detector conduits are welded to the nickel-based alloy bottom head penetration tubes. The bottom head penetration tubes are addressed in Application Table 3.1-1, Item 9. These tubes extend over eight inches from the bottom surface of the vessel. The configuration of the conduits tends to allow a significant temperature reduction from the Reactor Coolant System (RCS) temperature. Although no specific analysis has been performed, the lower temperatures of the conduit will substantially reduce the possibility of SCC. It is anticipated the conduit will be at ambient area temperature within several feet of the vessel bottom head.

Chemistry controls on the RCS significantly reduce the source of contaminates. Mechanical agitation of the fluid in the conduit can occur from incore thimble vibration and the minor movement that occurs during flux mapping. Mechanical agitation prevents the concentration of contaminants in the conduit near the vessel.

Measures are taken to prohibit the purchase of sensitized stainless steels and to prevent sensitization during component fabrication. FSAR Section 5.2.5, Austenitic Stainless Steel, provides more information on controls of austenitic stainless steel.

The combination of these factors reduce the probability of SCC for the conduit and justify that a one-time inspection of the conduit is not required.

Additional Information for RAI 3.1.2.4.3-6:

Confirm the reactor vessel flange leak detection line remains dry during normal operations, and if not, identify the actions that will be taken.

VCSNS Response Additional Information for RAI 3.1.2.4.3-6

The Reactor Vessel flange leak detection components are classified as Code Class 2 components and are not normally filled with borated water. This line connects between the two vessel o-rings to allow for monitoring of vessel o-ring leakage. Vessel o-ring leakage has not been a problem at VCSNS and this line has been dry during normal plant operations. An alarm exists on the Main Control Board to identify leakage. There are preplanned actions associated with Main Control Board alarms that include isolation of the line to contain the leakage and monitoring of the RCS leakage.