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**SOUTHERN COMPANY**
*Energy to Serve Your World*℠

June 23, 2008

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50-425

NL-08-0979

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D. C. 20555-0001

Vogtle Electric Generating Plant
License Renewal – Revised RAI Responses

Ladies and Gentlemen:

By letter dated June 27, 2007, Southern Nuclear Operating Company (SNC) submitted a License Renewal Application (LRA) for Vogtle Electric Generating Plant (VEGP) Units 1 and 2, seeking to extend the terms of the operating licenses an additional 20 years beyond the current expiration dates.

Since submittal of the LRA, SNC has responded to Nuclear Regulatory Commission (NRC) Requests for Additional Information (RAIs) by various letters. In response to questions raised during telephone conversations with the NRC staff, the responses to RAIs 2.3.3.19-1, 3.3-2 & 3.4-1, and 4.3-04 have been revised. The revised responses to these RAIs are provided in the Enclosure to this letter. Changes from the previous responses are indicated by revision bars adjacent to affected paragraphs.

(Affirmation and signature are provided on the following page.)

Mr. T. E. Tynan states he is a Vice President of Southern Nuclear Operating Company, is authorized to execute this oath on behalf of Southern Nuclear Operating Company and to the best of his knowledge and belief, the facts set forth in this letter are true.

The NRC commitments contained in this letter will be listed in the updated VEGP License Renewal Commitment List to be submitted separately. If you have any questions, please advise.

Respectfully submitted,

SOUTHERN NUCLEAR OPERATING COMPANY

T. E. Tynan

T. E. Tynan
Vice President – Vogtle

*Sworn to and subscribed before me this* 23 *day of* June, *2008.*

Sherry A. Chandler
*Notary Public*

Notary Public, Burke County, Georgia
*My commission expires:* My Commission Expires January 13, 2012

TET/JAM/daj

Enclosure: Revised Responses to RAIs 2.3.3.19-1, 3.3-1 & 3.4-1, and 4.3-04

cc: Southern Nuclear Operating Company
Mr. J. T. Gasser, Executive Vice President — w/o Enclosure
Mr. D. H. Jones, Vice President – Engineering — w/o Enclosure
Mr. M. J. Ajluni, Manager, Nuclear Licensing — w/ Enclosure
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U. S. Nuclear Regulatory Commission
Mr. L. A. Reyes, Regional Administrator — w/ Enclosure
Mr. R. A. Jervey, NRR Project Manager – Vogtle — w/ Enclosure
Mr. G. J. McCoy, Senior Resident Inspector – Vogtle — w/ Enclosure

State of Georgia
Mr. N. Holcomb, Commissioner – Department of Natural Resources — w/o Enclosure

**Vogtle Electric Generating Plant**
**License Renewal – Revised RAI Responses**

**Enclosure**

**Revised Responses to RAIs 2.3.3.19-1, 3.3-1 & 3.4-1, and 4.3-04**

# Vogtle License Renewal Revised RAI Responses

**RAI - 2.3.3.19-1**

The following LRA drawings show fire protection system components as out of scope:

LRA drawing CX4LD173-2 shows the following fire protection system's components out of scope (i.e., not colored in red):

- Fire Hydrants
- Fire Protection Piping to Turbine Building, Steam Tunnel, and Radwaste Solidification Building
- Intake Structure

LRA drawing CX4LD173-4 shows the following fire protection system's components out of scope in the following locations (i.e., not colored in red):

- Dry Active Waste Processing Facility
- Dry Active Waste Storage Building

LRA drawing 1X4LD174-1 shows the following Halon 1301 fire protection system's components out of scope in the following locations (i.e., not colored in red):

- Computer Room Level A
- Computer CRT Display and Communication Rooms Level 1
- Radwaste Solidification Building Contamination Oil Room Level 1
- Radwaste Solidification Building Elevation 192'-0"

LRA drawing 2X4LD174-1 shows the following Halon 1301 fire protection system's components out of scope in the following location (i.e., not colored in red):

- Computer Room Level A

The staff requests that the applicant verify whether the above systems and components are in the scope of license renewal in accordance with 10 CFR 54.4(a) and subject to an AMR in accordance with 10 CFR 54.21(a)(1). If these components are excluded from the scope of license renewal and not subject to an AMR, the staff requests that the applicant provide justification for the exclusion.

**VEGP Response:**
GENERAL

Fire protection SSCs that are relied upon in the event of a fire to maintain the ability to perform reactor plant safe shutdown functions at VEGP (including plant SSCs that are relied upon to perform safe shutdown in the event of a fire), or to minimize radioactive releases to the environment in the event of a fire are in-scope for license renewal. For the fire protection system, certain SSC's are in scope for license renewal and certain SSC's are not in scope, depending on whether they are relied upon for 10 CFR 50.48 and Branch Technical Position (BTP) CMEB 9.5-1 compliance or not (hereafter referred to as "regulatory compliance").

The current licensing basis (CLB) for VEGP's fire protection system is as follows:

The fire protection systems described in the VEGP FSAR conform to General Design Criterion 3 as stated in FSAR Section 3.0 (10 CFR 50, Appendix A, "General Design Criteria for Nuclear Power Plants", Criterion 3, "Fire Protection"). The scoping criteria in 10 CFR 54.4(a)(3) states that plant SSCs within the scope of this part are "…relied on in safety analyses or plant evaluations to perform a function that demonstrates compliance with the NRCs regulation for fire protection (10 CFR 50.48)..." In addition to compliance with General Design Criterion 3 and 10 CFR 50.48, VEGP also utilizes the detailed guidance of Branch Technical Position (BTP) CMEB 9.5.1, "Guidelines for Fire Protection for Nuclear Power Plants."

10 CFR 50.48 dictates that each licensee must have a fire protection plan (FPP) that satisfies Criterion 3 of Appendix A to 10 CFR 50. Criterion 3, "Fire Protection," stipulates:

"Structures, systems, and components important to safety shall be designed and located to minimize, consistent with other safety requirements, the probability and effect of fires and explosions. Noncombustible and heat resistant materials shall be used wherever practical throughout the unit, particularly in locations such as the containment and control room. Fire detection and fighting systems of appropriate capacity and capability shall be provided and designed to minimize the adverse effects of fires on structures, systems, and components *important to safety*. Firefighting systems shall be designed to assure that their rupture or inadvertent operation does not significantly impair the *safety capability* of these structures, systems, and components."

10 CFR 50.48 requires that the plan describe specific features necessary to implement the program such as automatic and manually operated fire detection and suppression systems, and the means to limit fire damage to SSCs important to safety so that the capability to shut down the plant safely is ensured.

The VEGP FPP is described in detail in the FSAR and was approved as described in the FSAR and other licensing documents by the NRC in the operating license:

"Southern Nuclear shall implement and maintain in effect all provisions of the approved fire protection program as described in the Final Safety Analysis Report for the facility, and submittals dated July 2, August 4 and 13, October 10 and 24, November 5, and December 19, 1986, and January 2, 1987, as approved in the SER (NUREG-1137) through Supplement 5 subject to the following provision:

"Southern Nuclear may make changes to the approved fire protection program without prior approval of the Commission, only if those changes would not adversely affect the ability to achieve and maintain safe shutdown in the event of a fire."

The SER (NUREG-1137) was reviewed through Supplement 9 to help make scoping determinations.

NUREG-1800 section 2.1.3.1.3, "Regulated Events," is a source of additional guidance on applying the scoping criteria of 10 CFR 54.4(a)(3). It states that "...all SSCs that are relied upon in the plant's CLB (as defined in 10 CFR 54.3), plant-specific experience, industry-wide experience (as appropriate), and safety analyses or plant evaluations to perform a function that demonstrates compliance with NRC regulations identified under 10 CFR 54.4(a)(3), are required to be included within the scope of the rule." In addition, it limits the extent of the review with the statement that "an applicant need not consider hypothetical failures or second-, third-, or fourth-level support systems in determining the SSCs within the scope of the rule for 10 CFR 54.4(a)(3)...This guidance is not intended to exclude any support system...that is specifically relied upon for compliance with, the applicable NRC regulation." The guidance also recognizes that "mere mention of an SSC in the analysis or evaluation does not necessarily constitute support of an intended function as required by the regulation." Thus, mention of a system, structure, or component in an analysis or evaluation (e.g., FSAR, etc.) does not in and if itself constitute reliance on the SSC for regulatory compliance. Fire protection components also exist solely to satisfy insurance requirements and are likewise not relied upon for regulatory compliance and are not in the CLB.

In general, every fire protection system, structure, and component was reviewed against the current licensing basis and scoping determinations were made based on whether the SSC is part of the CLB or not.

For the fire protection water system, portions of the system that are in scope for 10 CFR 54.4 a(3) are separated from portions of the system that are not in scope by manual isolation valves that are normally open. These valves remain normally open so that in the event of a fire in a not-in-scope portion of the system, water may be immediately available for fire suppression following automatic initiation of the detection/suppression system(s) in the not-in-scope portion. This also applies to not-in-scope yard fire hydrants that may be used to manually suppress fires. Should an age related pressure boundary failure occur in the not-in-scope portion of the system such that a significant system pressure drop results, an alarm would notify plant personnel and the fire water pump(s) would start automatically. Following the alarm and pump start, plant personnel would investigate the cause and manually close the isolation valve(s) separating the failed not-in-scope portion of the system from the in-scope portion, as warranted, considering the need to preserve fire water inventory for 10 CFR 50.48 compliance. The design of the system provides multiple pumps and a large volume of stored water which can be used to maintain system pressure while the location of a leak is identified and isolated. Ample time is available to isolate a leak in a not-scope location before operability of the 50.48 protection features can be affected. Therefore, terminating the license renewal boundary at an open manual isolation valve is acceptable.

The following is a breakdown of fire protection SSC's and a discussion of in-scope applicability:

1.) Drawing CX4LD173-2:
The fire protection piping to the Turbine Building (including steam tunnels) is not in scope because the fire protection system in the Turbine Building is not relied upon for regulatory compliance (FSAR Appendix 9B, paragraph C.7.h). Refer to the answer to RAI 2.1-2 for discussion regarding non-safety related components in the Turbine Building.

The fire protection system in the Radwaste Solidification Building is not in scope because the building has been abandoned in place and there is no radioactive material stored there (FSAR Section 11.4.2.4).

Since the Intake Structure is not in the scope of license renewal, the fire protection system in this structure is not in scope. See License Renewal Civil Boundary Drawing AX1D45L01.

The fire hydrants listed in FSAR Table 9.5.1-10D are required for regulatory compliance and are in scope and highlighted as such on the drawing. Those fire hydrants not in FSAR Table 9.5.1-10D are not required for regulatory compliance and are not in scope and thus not highlighted on the drawing.

The following is the basis for the scope of hydrants included for VEGP license renewal (portions of the criteria under "GENERAL" above are re-stated here for clarification):

10 CFR 54.4(a)(3) states:

> All systems, structures, and components relied on in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for fire protection (10 CFR 50.48) [are to be included in scope of license renewal]

10 CFR 50.48(a)(1) states:

> Each operating nuclear power plant must have a fire protection plan that satisfies Criterion 3 of appendix A to this part (10 CFR 50).

Criterion 3 of Appendix A to 10 CFR 50 states:

> Structures, systems, and components important to safety shall be designed and located to minimize, consistent with other safety requirements, the probability and effect of fires and explosions. Noncombustible and heat resistant materials shall be used wherever practical throughout the unit, particularly in locations such as the containment and control room. **Fire detection and fighting systems of appropriate capacity and capability shall be provided and designed to minimize the adverse effects of fires on structures, systems, and components important to safety**. Firefighting systems shall be designed to assure that their rupture or inadvertent operation does not significantly impair the safety capability of these structures, systems, and components.

The emphasis is added above to highlight the focus of the intent of fire protection systems considered in scope for license renewal. For VEGP a fire hazard analysis was performed defining the systems, structures and components important to safety and how those SSCs were protected in the event of fire. Additionally, a safe shutdown analysis was performed defining systems and processes required to bring the plant to safe shutdown in the event of a fire. The results of these analyses are documented in the VEGP UFSAR section 9.5.1 and Appendix 9A. As a result of that analysis, eleven hydrants in the plant were determined to be important for fighting fires that could impact important to safety SSCs. These hydrants were identified in UFSAR Table 9.5.1-10D as the hydrants in the plant that are required to remain operable (Reference Table 9.5.1-10 paragraph 6.1).

At the time the initial SER (NUREG 1137) was issued by NRC in review of the Vogtle FSAR during initial licensing (June 1985), the fire hazard safe shutdown analysis was not complete and could not be evaluated by the NRC reviewers. As a result the SER noted on page 9-49:

> Safe Shutdown Capability
>
> The applicant has indicated that its analysis of safe shutdown capability will be completed in September 1985. The staff will review this information when available and address it in a supplement to this SER. It is an open item.

Additionally, the SER noted on page 9-51:

> Fire Protection Water Supply System
>
> Hydrants are provided in the yard at intervals of less than 250 feet along the fire protection water supply loop. **The lateral to each yard hydrant is provided with a key-operated isolation valve to facilitate maintaining and repairing the hydrants without shutting down any part of the system**. Standard hose houses are provided in accordance with NFPA Std. 24.

This section was primarily descriptive of how the plant implemented the requirements of NFPA Std 24 which is required by CMEB 9.5.1. Additionally, it noted that the hydrants could be isolated and repaired without impacting the ability of the system to provide flow to SSCs important to safety as required by Criterion 3 of Appendix A to 10 CFR 50. It did not describe hydrants required to provide fire water to SSCs important to safety since that information was still in development at the time of the initial SER.

SER supplement 4 (December 1986) was issued to address the safe shutdown analysis. Additionally, this supplement became the current review of the fire hazard analysis in place of the initial SER due to the significant changes made to the analysis from the initial SER (Note Supplement 3 to NUREG 1137, page 9-1). Table 9.5.1-10D was included in Amendment 28 to the FSAR, which was part of the changes addressed in supplement 4. This supplement became the acceptance document of the revised fire hazard analysis and the safe shutdown analysis.

Table 9.5.1-10D at the time of supplement 4 consisted of four hydrants for Unit 1. After Unit 2 commercial operation, LDCR 1989-010 was issued adding seven hydrants to Table 9.5.1-10D for Unit 2. This table has not changed from that time. Therefore, the fire hydrants included in scope for license renewal encompass the fire hydrants reviewed and approved by the NRC as part of the original licensing basis of VEGP.

2.) Drawing CX4LD173-4:
The fire protection systems in the Dry Active Waste Processing Facility and Dry Active Waste Storage Building are in the scope of license renewal. Although these buildings are in the scope of license renewal, they are categorized as structures and are not highlighted on mechanical boundary drawing CX4LD173-4 because this drawing is strictly a mechanical boundary drawing as stated in the drawing title block. Structures are sometimes shown on mechanical boundary drawings for clarity in describing the mechanical system, but the structure itself is not highlighted on the mechanical boundary drawings. For the highlighted in-scope structures, see License Renewal Civil Boundary Drawing AX1D45L01.

3.) Drawing 1X4LD174-1:
The Halon systems in the Computer Room Level A, Computer CRT Display and Communication Rooms Level 1, Radwaste Solidification Building Contamination Oil Room Level 1, and the Radwaste Solidification Building Elevation 192'-0" are shown not highlighted on drawing 1X4LD174-1. FSAR Table 9.5.1-10, paragraph 4.1, lists the fixed Halon systems required for regulatory compliance and these systems are highlighted on drawing 1X4LD174-1. The above listed Halon systems are not in this table because they are not required for regulatory compliance and are thus not in the scope of license renewal. The fire protection system in the Radwaste Solidification Building is not in scope because it has been abandoned in place and there is no radioactive material stored there (FSAR Section 11.4.2.4).

4.) Drawing 2X4LD174-1:
The Halon system in the Computer Room Level A is shown not highlighted on drawing 2X4LD174-1. FSAR Table 9.5.1-10, paragraph 4.1, lists the fixed Halon systems required for regulatory compliance and these systems are highlighted on drawing 2X4LD174-1. The above listed Halon system is not in this table because it is not required for regulatory compliance and is thus not in the scope of license renewal.

# Vogtle License Renewal Revised RAI Responses

**RAI - 3.3-1 & 3.4-1**

Regarding the use of AMP's (e.g., the External Surfaces Monitoring Program) that credit visual examinations of external polymer (including elastoers, thermoplastics, thermoset, or rubber materials) surfaces, justify your basis for crediting the AMP for aging management of cracking and changes in material properties of the polymetric materials. Clarify how a visual examination alone is capable of detecting a crack or a change in a specific material property (such as a change in a hardness, strength, elasticity or fracture toughness property) in these type of materials.

**VEGP Response:**

The VEGP External Surfaces Monitoring Program does not credit visual examination alone for detecting changes in material properties (including cracking) of polymeric materials.

Visual examinations will be performed to detect discontinuities and imperfections on the surface of components, including such conditions as cracking, peeling, blistering, chalking, crazing, delamination, flaking, discoloration, physical distortion.

In addition, the VEGP External Surfaces Monitoring Program refers to EPRI guidance documents (primarily EPRI 1007933) that provide for the use of tactile techniques in conjunction with visual examination as described above. Tactile techniques include scratching the material surface to screen for waxy or chalky residues (which can be indicative of polymer breakdown), pressing the polymer to qualitatively evaluate resiliency, bending or folding the polymer to identify crazing (surface cracking) or whitening (which can be indicative of reduced bonding of the filler), and stretching to evaluate tear resistance.

VEGP credits both visual examination and tactile examination techniques as described in EPRI guidance documents for aging management of polymeric materials which are in the scope of the External Surfaces Monitoring Program.

# Vogtle License Renewal Revised RAI Responses

**RAI - 4.3-04**

In a letter dated February 21, 2008, the applicant submitted its response to RAI 4.3-4, regarding Table 4.3.1-3, Evaluation of Environmental Effects on Fatigue, of the LRA. The applicant provides the analysis results for cumulative usage factor (CUF) values of the charging nozzle and the surge line hot leg nozzle for different transients. Upon review of the response as well as Table 4.3.1-3 of the LRA, the staff identified several areas where additional information is needed for the staff to complete its review. Please note that questions a through i pertain to the letter response.
a. Figure 1 and Figure 2, the temperature transient curves for the changing nozzle, are missing from the response. Please provide them.
b. The locations for the charging nozzle and the surge line hot leg nozzle are at the safe-end region. Confirm the critical fatigue locations are at the safe-end region and provide supporting analysis results.
c. Sections 4.5.4 and 5.5.4 state that "FatiguePro stress output for each transient was used as guidance to split the transient up into sub-transients." In addition, the FatiguePro stress output, Figure 9, shows that 1-D stress versus time was plotted. Explain how this graph was used in determining the stress intensity and explain why this graph was used instead of the temperature transient curve.
d. The maximum range of linearized membrane plus bending stress from FatiguePro is taken as 2/3 times the peak stress range for the charging nozzle. What is the basis for the 2/3 factor? In addition, please explain the basis for using 17/20 factor to calculate maximum range of linearized membrane plus bending stress for surge line.
e. For the charging nozzle, the location of high fatigue usage is protected by the thermal sleeve. Why is the alternating stress so high? Do both analyses use the same peak stress index at that location?
f. The analyses are based on the 1986 Edition of the ASME Code. Does the FatiguePro analysis, which is based on NB-3600, exclude the linear thermal gradient when computing the strain concentration factor, Ke.
g. For the surge line hot leg nozzle, was a temperature variation in the circumferential direction used in the analysis? If so, how was it accounted for in FatiguePro?
h. Section 4.5.1 states nominal stress components due to piping loads are multiplied by 1.8 to yield P+Q+F stress components. Describe the basis for using 1.8 factor in the ASME NB-3200 analysis.
i. The February 21, 2008 response did not address the safety injection nozzle. Indicate whether the safety injection nozzle CUF calculated using FatiguePro would bound the CUF value calculated using the ASME-3200 methodology and provide the basis for the conclusion.
j. Table 4.3.1-3 of the LRA indicates that the RHR line inlet transition nozzle had a design CUF of 0.95. Explain why the Unit 1 and Unit 2 60-year projected CUF is significantly lower than the design CUF.

**VEGP Response:**

a. When the attachment to NL-08-0228 was converted to pdf format, the page with Figures 1 and 2 was inadvertently left out. They are included below.

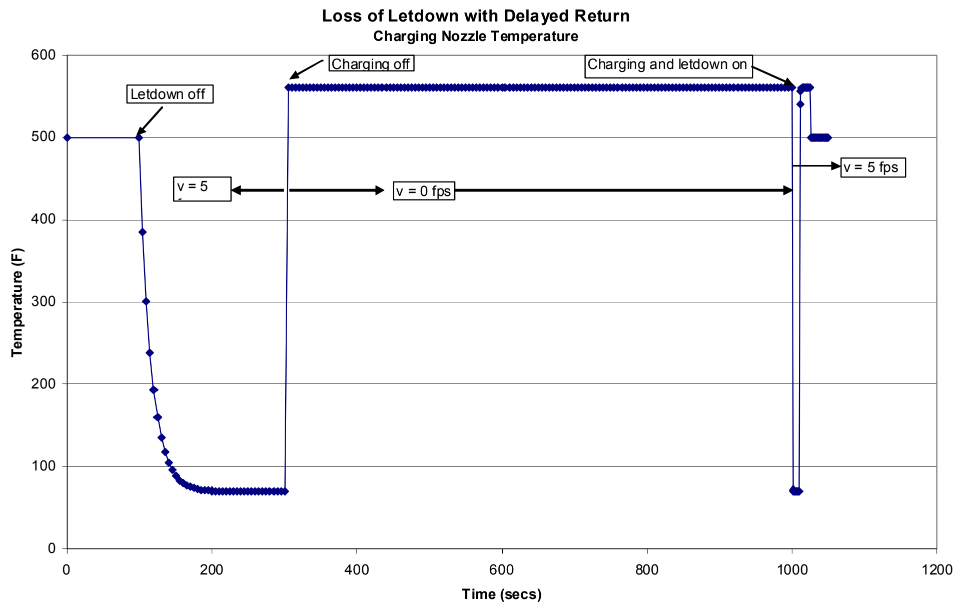


Figure 1: Design Transient for Fast Transient

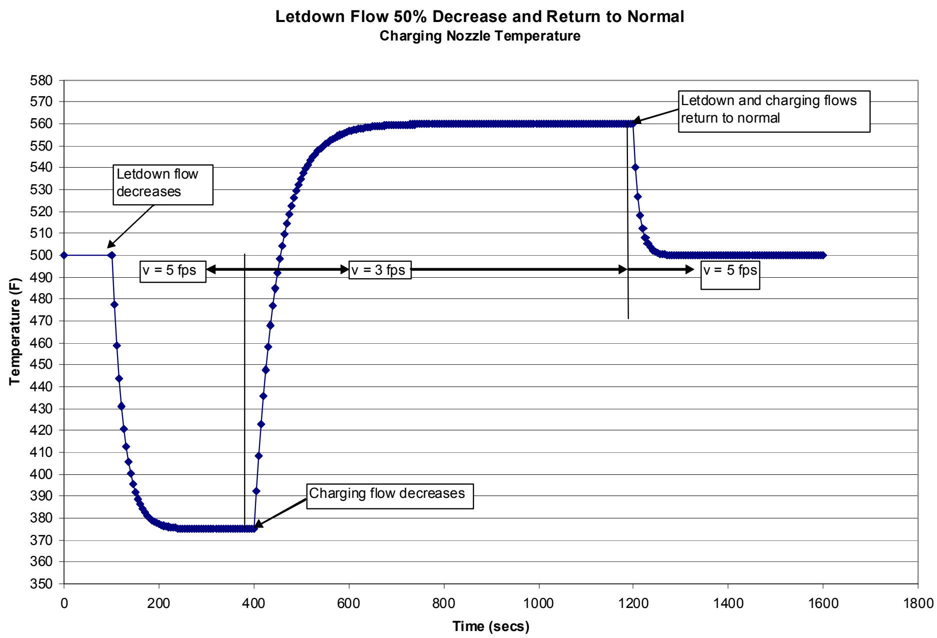


Figure 2: Design Transient for Slow Transient

b. The principal contributor to CUF at the charging nozzle is the letdown shutoff with delayed return transient, which includes essentially a step change in temperature. The charging nozzle analysis selected the safe-end region as the critical location, based on the results of a finite element stress analysis for a large temperature step change. This is consistent with the analysis results presented in NUREG/CR-6260 (INEL-95/0045), Section 5.5.4. This demonstrated, using an NB-3200 analysis of a Westinghouse plant charging nozzle, that the maximum CUF occurs on the nozzle upstream of the thermal sleeve.

Westinghouse provided stress model input for the Vogtle surge line hot leg nozzle in WCAP-14173, Rev. 3. Section D.3.0 of that document states that the critical location in the Surge Line Hot Leg Nozzle was determined to be in the safe end region. This was concluded based on the analyses performed for Vogtle addressing NRC Bulletin 88-11 surge line thermal stratification effects, as documented in WCAP-12218 and WCAP-12219 and their supplements. In those evaluations, the maximum usage factor in the surge line hot leg nozzle occurred at the safe end. Calculations supporting the conclusions of WCAP-12218, WCAP-12219, and WCAP-14173, Rev. 3, are available in the Westinghouse offices for review.

c. The FatiguePro stress output was not used to determine stress intensity in the NB-3200 benchmark analysis. Figure 9 was only used by the analyst for initial guidance to identify the portions of the transient when conditions are at an extreme for the cycle (i.e., per NB-3216.2(b)). The Figure 9 stress provides a simple plot which identifies the extremes of the transient as well as - or possibly better than - the temperature trace.

d. Structural Integrity Associates performed a finite element analysis of the charging nozzle that calculated both Primary plus Secondary stress ($S_n$) and Total Peak stress ($S_p$) at the critical location in response to a large temperature step change. From that data, the maximum ratio of $S_n$ to $S_p$ was determined over the time when the stress response was within 80% of the peak value. Fatigue usage for the charging nozzle is driven chiefly by abrupt changes in temperature, for example during the thermal transient Loss of Letdown with Delayed Return to Service. Therefore, the above ratio will conservatively bound the actual ratio of $S_n$ to $S_p$ for any actual transients where the strain concentration factor $K_e$ may be greater than 1.0.

Westinghouse provided stress model input for the Vogtle surge line hot leg nozzle in WCAP-14173, Rev. 3. Section D.3.3 of WCAP-14173, Rev. 3, states that the ratio of Primary plus Secondary stress to Total Peak stress to use for evaluation is $R_Q = 0.85$. The value of the ratio was determined using the detailed results of the fatigue evaluation performed for Vogtle addressing NRC Bulletin 88-11 surge line thermal stratification effects, documented in WCAP-12218 and WCAP-12219 and their supplements. The fatigue evaluation for the nozzle safe end was examined to determine the ratio of Primary plus Secondary stress ($S_n$) to Total stress ($S_p$) for a number of fatigue pairs whose contributions to the cumulative usage factor were most significant. Pairs examined included those dominated by local and global thermal stratification effects, and also those dominated by global stratification moment effects, to assure that a range of conditions that could occur in actual operation was examined. The resulting ratios ranged from 0.45 to 0.82. Therefore, an enveloping value of 0.85 was conservatively chosen for the monitoring model.

e. As discussed in the response to part (b), the nozzle safe-end to pipe weld is the critical location in all analyses that have been submitted to-date. This location is not protected by a thermal sleeve. The alternating stress is high in both parts of the benchmark analysis, principally because the maximum possible $K_e$ strain concentration factor of 3.333 was computed.

Note that the recent fatigue analyses were performed to ASME NB-3200, while the design stress analyses were performed to NB-3600. The Critical location for the NB-3200 analyses is the safe-end, while the critical location for the NB-3600 analysis is the nozzle corner. Thus, the recent analyses use different peak stress indices than the design analysis, since they have different critical locations.

f. The FatiguePro analyses did not exclude the linear thermal gradient when computing $S_n$ and $K_e$. FatiguePro stress transfer function logic does not strictly adhere to ASME NB-3600, but takes guidance from it where appropriate for the piping component being analyzed. Since the finite element analysis of the charging nozzle computed stresses that included some portion of axial temperature gradient, it is conservative to include the linearized thermal stresses from the finite element model in the Q stress term.

   Starting with the 1977 edition/Summer 1979 addenda, ASME Code, Section NB-3200, Table NB-3217-2 allows classification of stress due to linear radial temperature gradient as peak stress. A more refined NB-3200 fatigue analysis that separates stresses due to linear radial temperature gradient from axial temperature gradient would provide a significant reduction in conservatism compared to the FatiguePro analysis.

   It should be noted that the NB-3200 benchmark analysis also retained the full linearized thermal stresses in the Q term. This was done intentionally to maintain consistency with the FatiguePro analysis and isolate the effects of stress combinations on the relative results.

g. Temperature variation in the circumferential direction was used in the analysis. In WCAP-14173 Rev. 3, Westinghouse provided stress Green's functions due to temperature application on the top of a thermally stratified interface, and also from temperature application on the bottom. The resultant local stress at the monitored location due to stratification is determined using superposition of the stresses.

h. The nozzle is attached to the piping with a butt weld. To determine fatigue strength reduction factors, guidance is taken from the local stress indices (K indices) from NB-3600. For stresses due to piping loads, Table NB-3681(a)-1 provides a $K_2$ stress index of 1.8 for an as-welded transition or girth butt weld. The resulting stress is bounding in the safe-end region for any piping load.

i. The 3" HPSI (BIT) nozzle was analyzed using a Cycle Counting Event Pairing (CCEP) methodology. Since this method does not use a 1D stress approach, it was not included in the benchmarking analysis.

   The CCEP methodology is described in Section 3.6.2 of EPRI report TR-107448, December 1997. The FatiguePro CCEP algorithm for the Vogtle HPSI nozzle is based on the fatigue table developed in the Westinghouse design stress report. It will produce the design CUF value for the design number of cycles; it computes a proportional usage value for fewer than the design number of cycles. The computed CUF is provably greater than or equal to the usage of an equivalent code fatigue analysis, given the same numbers of cycles.

j. Note that the design usage of 0.95-and the low projected CUF-were computed for the 10" 45° Accumulator Injection nozzle, which was identified as the "RHR line inlet transition nozzle" per NUREG/CR-6260.

   The design CUF was computed using a full Code design analysis, and 91% of the usage is due to 4 upset (& 1 faulted) events: *Inadvertent RCS Depressurization*, *High-Head SI*, *Inadvertent*

*ACC Blowdown*, *OBE*, and *Post-LOCA Operation*. During actual plant operation, very few of these events have occurred, and very few are projected to occur over the next 40-45 years. The lower projected CUF reflects this fact.

Another significant contributor to CUF is the initiation of RHR flow during plant cooldown. Actual plant data has shown that RHR flow typically initiates at the end of plant cooldown, when the temperature difference between the injection flow and the reactor coolant system is relatively small. This further reduces the expected lifetime CUF.

Ultimately, if the rate of occurrence or severity for any of these events increases, it will be captured by the monitoring system and be reflected in the monitored CUF reports and projections. If the monitored CUF increases to the action levels established by the plant, it will initiate corrective actions (e.g., re-analysis).

The answers above, particularly for items b and e, are based on the Vogtle charging nozzle and hot leg surge nozzle having thermal sleeves. Based on recent industry findings, VEGP researched its current configuration and determined that the design basis analyses for these connections did not include thermal sleeves and thermal sleeves were removed from the RCS branch connections. Based on this finding, it is no longer certain that the safe-end location is bounding for the charging nozzle. Westinghouse has confirmed that the safe end is still bounding for the hot leg surge nozzle.

Due to recent discussions with regard to fatigue monitoring software methodology for stress-based fatigue monitoring, VEGP is currently re-evaluating the software to be used for metal fatigue monitoring in the period of extended operation. Therefore, for those locations for which an aging management program is required in the period of extended operation, SNC commits to implement a fatigue management software program that uses six stress components in the stress-based fatigue calculation. The software will be appropriately benchmarked against an ASME NB-3200 fatigue analysis and the stress-based fatigue monitoring locations will be modeled with the as-built configuration. The new software will be used to re-project 60-year CUF values for the monitored locations. When those locations were evaluated for environmental effects on fatigue, the new software will also be used to demonstrate the environmental effects on fatigue will be adequately managed for those locations during the period of extended operation. This software will be put in service at least two years prior to the period of extended operation.