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SOUTHERN COMPANY
Energy to Serve Your World℠

May 29, 2008

Docket Nos.: 50-424
50-425

NL-08-0837

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

Vogtle Electric Generating Plant
License Renewal - Responses to 04/28/2008 RAIs

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.

By letter dated April 28, 2008, the Nuclear Regulatory Commission (NRC) submitted Requests for Additional Information (RAIs) to SNC resulting from the NRC staff review of the LRA. The SNC responses to these RAIs are provided in the enclosure to this letter.

(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 next update of the License Renewal Future Action Commitment List. 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 29 *day of* May, *2008.*

Sherry D. Chandler
Notary Public

Notary Public, Burke County, Georgia
My Commission Expires January 13, 2012

My commission expires: ________

TET/JAM/daj

Enclosure: Responses to April 28, 2008 License Renewal RAIs

cc: <u>Southern Nuclear Operating Company</u>

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
Mr. N. J. Stringfellow, Licensing Supervisor, Vogtle	w/ Enclosure
RType: CVC7000	

<u>U. S. Nuclear Regulatory Commission</u>

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

<u>State of Georgia</u>

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

Vogtle Electric Generating Plant

Enclosure

Responses to April 28, 2008 License Renewal RAIs

Vogtle License Renewal Audit Questions and Answers

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 types of materials.

VEGP Response:

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

Vogtle License Renewal Audit Questions and Answers

<u>RAI</u> - 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 valve 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.

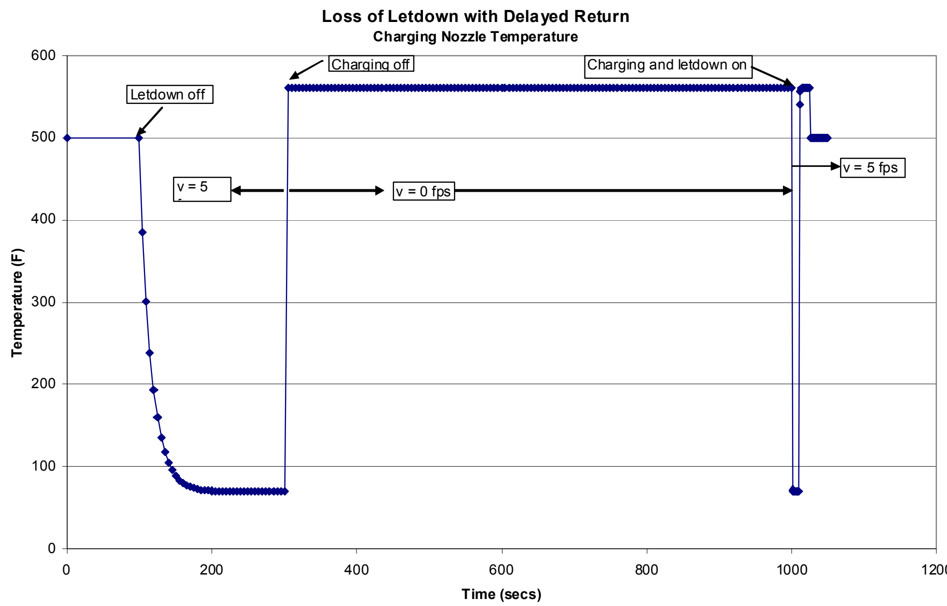

Figure 1: Design Transient for Fast Transient

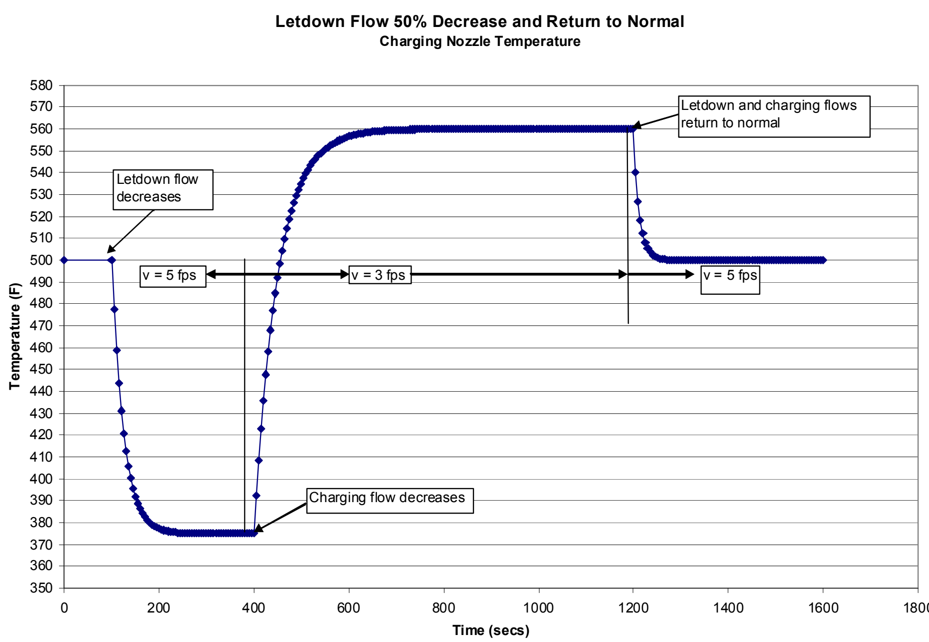

Figure 2: Design Transient for Slow Transient

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 reevaluating 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 will use six stress components in the stress based fatigue calculation. The software will be appropriately benchmarked and the stress based fatigue monitoring locations will be modeled with as-built configuration. This software will be put in service at least two years prior to the period of extended operation.

Vogtle License Renewal Audit Questions and Answers

RAI - 4.7.5-1

In Southern Nuclear's Letter No. NL-08-0195, dated March 20, 2008 (ADAMS ML090910440), the applicant amended the LRA to provide its TLAA on underclad cracking of those reactor pressure vessel (RPV) components that are made from SA-508, Class 2 low alloy steel forgings Section 4.7.5) states the flaw growth analysis in WCAP-15338 for Westinghouse-designed reactors is bounding for the 4-loop reactors at Vogtle and that this TLAA is acceptable in accordance with the provisions in 10 CFR 54.21(c)(1)(i). In section 4.1 of the staff's safety evaluation on WCAP-15338, the staff identified two (2) renewal applicant action items on the use of this WCAP for a facility's licensing basis. In the first action item, the staff requested that, for 2-loop and 4-loop Westinghouse PWR's, the renewal applicant should demonstrate that the transients for normal, upset, emergency, faulted, and pressurized thermal shock (PTS) conditions used WCAP-15338 report bound their plant-specific transients for these conditions; otherwise, the staff requested that the applicant perform similar Section X1 flaw evaluations with underclad cracks are acceptable for 60 years of operation. In the second action item, the staff requested that the applicants referencing the WCAP-15338 report for the RPV components shall ensure that the evaluation of the TLAA is summarily described in the FSAR supplement. The staff has verified that the amendments of the LRA in Letter No. Nl-08-0195 provided UFSAR Supplement for this TLAA that satisfies applicant action item No. 2 from the staff's SE on WCAP-15338. However, the staff has determined that the new TLAA section does not address how the transients for normal, upset, emergency, faulted, and PTS conditions used in WCAP-15388 bound their plant-specific transients for these conditions at Vogtle. The staff requests that SNOC provide clarification on how the normal, upset, emergency, faulted, and Pressurized Thermal Shock (PTS) conditions used WCAP-15388 report bounds the plant-specific transients for these conditions at Vogtle reactor units.

VEGP Response:

The design cycles and transients for VEGP are reported in Table 3.9.N.1-1 of the VEGP UFSAR and restated in LRA Table 4.3.1-1. The numbers of design cycles and transients assumed in the WCAP-15338 analysis bound the numbers of design cycles and transients projected for 60 years of operation presented in Table 4.3.1-1 with regard to underclad flaw growth. Therefore, action item 1 from the staff's safety evaluation on WCAP-15338 is satisfied.