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U. S. Nuclear Regulatory Commission
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Vogtle Electric Generating Plant – Units 1 & 2
Joseph M. Farley Nuclear Plant – Unit 1
Response to Follow-up Request for Information Regarding Reactor Pressure Vessel
Threads-in-Flange Examination Requirement

Ladies and Gentlemen:

By application dated August 4, 2016 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML 16221A072), as supplemented by letter dated October 24, 2016 (ADAMS Accession No. ML 16298A049) Southern Nuclear Operating Company (SNC) submitted Alternative VEGP-ISI-ALT-11, Version 2.0, for the Vogtle Electric Generating Plant, Units 1 and 2, and Alternative FNP-ISI-ALT-19, Version 2.0, for the Joseph M. Farley Nuclear Plant, Unit 1. These Alternatives propose to eliminate the reactor pressure vessel (RPV) threads-in-flange examination requirement as an alternative to certain requirements of Section XI of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code for inservice inspection of RPV components.

By letter dated November 16, 2016, the Nuclear Regulatory Commission (NRC) staff requested additional information to complete its review. The Enclosure provides the SNC response.

This letter contains no NRC commitments. If you have any questions, please contact Ken McElroy at 205.992.7369.

Respectfully submitted,

C. R Pierce

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CRP/RMJ

Enclosure: SNC Response to NRC Request for Additional Information

cc: <u>Southern Nuclear Operating Company</u>
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Mr. D. D. Sutton, Regulatory Affairs Manager – Vogtle 1 & 2
RType: Farley=CFA04.054; Vogtle=CVC7000

<u>U. S. Nuclear Regulatory Commission</u>
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Vogtle Electric Generating Plant – Units 1 & 2
Joseph M. Farley Nuclear Plant – Unit 1
Response to Follow-up Request for Information Regarding Reactor Pressure
Vessel Threads-in-Flange Examination Requirement

Enclosure

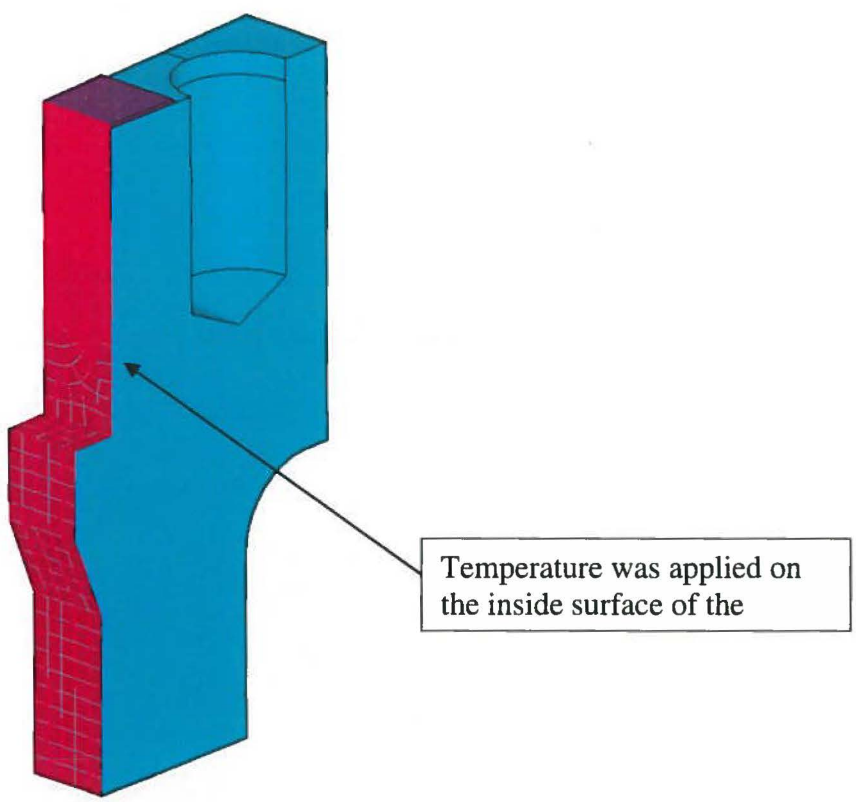
SNC Response to NRC Request for Additional Information

Follow-up RAI-1 (Related to NRC RAI-5, Question 2a)

The licensee's response to the previous RAI-5, Question 2a, indicated that, "Thermal loads are applied as uniform surface convection on the inside surface only." This response did not clarify how the heatup transient was applied. Please provide: (a) the thermal boundary conditions for the top, bottom, and RPV flange outer surfaces to confirm that this part of modeling is appropriate, and (b) a revision of the response to this RAI regarding how the heatup transient was applied to the thermal model since the application of thermal loads was not answered clearly.

Revised Response Related to RAI-5, Question 2a:

Internal pressure is applied uniformly on the inside surface of the model, and an endcap load is applied to the bottom surface. Thermal loads are applied as uniform surface convection on the inside surface only, using a conservative surface heat transfer coefficient (HTC) of 10,000 Btu/hr/ft^2, while the top, bottom, RPV outer, and circumferential symmetry planes surfaces are assumed adiabatic thermal boundary conditions. The figure below shows the applied temperature on the inside surface of the model (shown in RED), which was a linear ramp from 70°F to 600°F at rate of 100°F/hour using a HTC of 10,000 Btu/hr/ft^2. No temperature or HTC was applied on the above mentioned other surfaces of the model.



Follow-up RAI-2 (Related to NRC RAI-5, Question 3)

Regarding selection of heatup transient instead of cooldown transient in the FEM analysis, the licensee's response to NRC RAI-5, Question 3 states that, "Since heatup and cooldown have the same temperature change rate, in linear elastic analysis they will produce identical maximum and minimum stress range for crack growth calculation, despite an opposite time history." The above description of stresses is not consistent with the similar P-T limits

application (ignoring the crack growth part because it does not apply to the P-T limit application), of which the cooldown transient will create tensile stresses in the RPV inner wall and compressive stresses in the outer wall, and vice versa for the heatup transient. Please provide additional discussion on your response to NRC RAI-5, Question 3 to justify that heatup and cooldown transients will produce identical maximum and minimum stress ranges.

Revised Response Related to RAI-5, Question 3:

Since heatup and cooldown have the same temperature change rate, in linear elastic analysis they will produce identical maximum and minimum stress range for crack growth calculation, despite an opposite time history. This assumes a single material and no pressure loading. For heatup, the RPV starts from a stress-free steady state of 70°F to a stress-free steady state of 600°F. For cooldown, the RPV starts from a stress-free steady state of 600°F to a stress-free steady state of 70°F. During the transients, heatup and cooldown produce maximum tensile and maximum compressive stresses at opposite time points of the transient history, and produce the same stress range (maximum stress minus minimum stress) at each node point. Therefore, only one transient needs to be analyzed, and the heatup transient was chosen. The combined number of cycles from heatup and cooldown were used in the subsequent fatigue crack growth calculation.

Follow-up RAI-3 (Related to NRC RAI-5, Question 4a)

The licensee's response to NRC RAI-5, Question 4a indicated that, "the FEM model for the applied K determination is the same as the FEM model for the stress determination." Please clarify how loads are applied to both the FEM model for the stress determination and the FEM model for the applied K determination.

Revised Response Related to RAI-5, Question 4a:

It is confirmed that the FEM model for the applied K determination is the same as the FEM model for the stress determination. The loads were applied on the two models using an identical approach. The purpose of performing the stress determination on the model without crack tip elements was to determine the appropriate location to insert the crack tip elements. Once that location is identified, the analyses were repeated using the model with crack tip elements to determine the K results. For example:

- Internal pressure was applied uniformly on the inside surface of the stress and crack tip elements models.
- Convective heatup heat transfer load was applied on the inside surface of the stress and crack tip elements models to determine temperature. Then the temperature results were imported to the corresponding stress or crack tip elements models to determine the stress or K results.

Follow-up RAI-4 (Related to NRC RAI-5, Question 6)

The licensee's response to NRC RAI-5, Question 6 indicated that, "the maximum calculated K at any crack depth is about 20 ksi$\sqrt{in}$. This requires a K_{IC} of $20\sqrt{10}$ = 3.2 ksi$\sqrt{in}$." The K_{IC} of 3.2 ksi$\sqrt{in}$ may be a misprint of 63.2 ksi$\sqrt{in}$. Please provide the operating temperature at the time when K is 20 ksi$\sqrt{in}$ to justify that, "an RT_{NDT} of up to 70°F will not affect the results."

Response Follow-up RAI-4:

The correct K_{IC} to be used is 63.2 ksi√in. Recognizing that only the heatup transient was used in the analysis as explained above, the temperature at the time and location where K = 20 ksi√in is 528°F. This of course would be different in the case of the cooldown transient. Nevertheless, the minimum temperature considering either of the two transients would be 70°F which is higher than the RT_{NDT} of the flange regions of VEGP and FNP (the RT_{NDT} for the flange region is 20°F for VEGP Unit 1, 10°F for VEGP Unit 2, and 60°F for FNP Units 1 and 2). Hence, the acceptance criterion of IWB-3612 of ASME Code Section XI would be met at all temperatures.