November 28, 2006

William A. Eaton, BWRVIP Chairman
Entergy Operations
Echelon One
1340 Echelon Parkway
Jackson, MS 39213-8202

SUBJECT: STAFF EVALUATION OF BWRVIP RESPONSE TO NUCLEAR REGULATORY COMMISSION SAFETY EVALUATION OF "BWR VESSEL AND INTERNALS PROJECT, EVALUATION OF CRACK GROWTH IN BWR SHROUD VERTICAL WELDS (BWRVIP-80 REPORT)" (TAC NO. MC7400)

Dear Mr. Eaton:

By letter dated July 27, 2004, you provided the Boiling Water Reactor Vessel and Internals Project (BWRVIP) response to the staff's safety evaluation report (SER) dated February 19, 2003, regarding the Electric Power Research Institute's (EPRI's) proprietary report, "BWR Vessel and Internals Project, Evaluation of Crack Growth in BWR Shroud Vertical Welds (BWRVIP-80)," dated May 2000. Your letter provided additional information addressing each of the issues identified in the staff's SER for the BWRVIP-80 report.

In the staff's SER dated February 19, 2003, there were five issues that the staff requested that the BWRVIP address. The first issue was regarding the use of operating stresses arising from upset and emergency conditions in the crack growth evaluations in addition to the normal operating stresses. In the letter dated July 27, 2004, the BWRVIP indicated that it would modify Section 3.1 of the report to state, "For calculation of K_I to be used in crack growth determination, the sustained normal operating stresses are considered." The BWRVIP also stated that these stresses are discussed in the previous section of the BWRVIP-80 report and provided a summary of the stresses. Based on this information, the staff finds that the BWRVIP has adequately addressed the staff's concern regarding the consideration of operating stresses in the crack growth evaluation.

The second issue was in regards to the continuation of performing experimental studies as materials become available in order to continue to refine the analytical model. The BWRVIP, in its response, indicated that it plans to develop additional crack growth data in the future and to refine the analytical model if warranted. The staff finds the BWRVIP's response acceptable because the BWRVIP will continue to perform experimental studies and refine the analytical model as needed.

The third issue, as addressed in the SER for the BWRVIP-80 report, was regarding the uncertainty over the fit-up/construction stresses and the staff's concerns in the BWRVIP-14 report, "Evaluation of Crack Growth in BWR Stainless Steel RPV Internals," regarding local weld repairs. Based on these concerns, the staff requested that the BWRVIP continue to perform experimental studies as materials become available in order to refine the analytical model to more closely approximate the as-found conditions. The staff also requested that if the extent of weld repairs cannot be documented, the bounding crack growth rate (CGR) should be used for flaw evaluations. The staff further suggested that this issue be addressed in future technical meetings and that a future supplement to the BWRVIP-80 report be prepared, as needed. The BWRVIP indicated in its response that the approach that was agreed upon with respect to the BWRVIP-14 report was to conservatively bound these stresses with a global membrane stress and a surface residual stress distribution. The BWRVIP also stated that the same approach has been used in BWRVIP-80 except that because of the nature of the stress distribution, a global bending stress was used in lieu of the global membrane stress that was used in BWRVIP-14. The BWRVIP also indicated that the same surface residual stress distribution used in BWRVIP-14 was used in this case also.

The staff has determined that the BWRVIP's proposed addition of surface stresses and bending stresses for core shroud vertical welds provides sufficient margin against through-wall growth of flaws. Therefore, in lieu of the use of the bounding CGR, the surface stresses and bending stresses as proposed in the BWRVIP-80 report can be used for the calculation of stress intensity factors for the growth of flaws in the through-wall direction. However, the staff recommends that the BWRVIP include a clarification in the -A version of the BWRVIP-80 report stating that a [ ] ksi bending stress is to be added to the weld residual stress distribution for the crack growth calculation.

The fourth issue was regarding the staff's suggestion that while the stresses considered in the evaluation may be sufficiently conservative for unirradiated welds, additional conservatisms might be required for the welds in the high fluence region of the shroud. The BWRVIP stated in its response that it has submitted the BWRVIP-99 report, "Crack Growth Rates in Irradiated Stainless Steel in BWR Internal Components," to the Nuclear Regulatory Commission (NRC) to address the effects of high fluences ([ ] n/cm^2 up to [ ] n/cm^2 (E> 1 MeV)) on crack growth in shroud vertical welds. The BWRVIP further stated that the BWRVIP-80 report only addresses fluences below the threshold of [ ] n/cm^2 (E> 1 MeV). The BWRVIP also stated that it will address the effects of high fluence on crack growth in shroud vertical welds in a revision to the BWRVIP-99 report in the future. Based on the above, the staff finds the BWRVIP's response acceptable.

Lastly, the staff notes that it incorrectly stated in its SER that the CGR of [ ] n/cm^2 corresponds to conductivities of [ ] µS/cm and an electrochemical potential (ECP) of [ ] mV (SHE). The staff recognizes that the CGR of [ ] n/cm^2 corresponds to normal water chemistry conditions having an ECP of [ ] mV (SHE).

The staff has reviewed the BWRVIP's responses and finds that the BWRVIP has adequately addressed the issues raised in the staff's SER of the BWRVIP-80 report. The staff requests that the BWRVIP incorporate the staff's recommendations, as stated above, as well as your responses to the issues raised in the staff's SER, into the -A version of the BWRVIP-80 report. The staff also requests that the BWRVIP submit to the NRC the -A version of the BWRVIP-80 report within 180 days of receipt of this letter. Please contact me at (301) 415-1467, if you have any further questions regarding this subject.

Sincerely,

/RA/ Carolyn Fairbanks for

Matthew A. Mitchell, Chief
Vessels & Internals Integrity Branch
Division of Component Integrity
Office of Nuclear Reactor Regulation

cc: BWRVIP Service List

The staff has reviewed the BWRVIP's responses and finds that the BWRVIP has adequately addressed the issues raised in the staff's SER of the BWRVIP-80 report. The staff requests that the BWRVIP incorporate the staff's recommendations, as stated above, as well as your responses to the issues raised in the staff's SER, into the -A version of the BWRVIP-80 report. The staff also requests that the BWRVIP submit to the NRC the -A version of the BWRVIP-80 report within 180 days of receipt of this letter. Please contact me at (301) 415-1467, if you have any further questions regarding this subject.

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Matthew A. Mitchell, Chief
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Office of Nuclear Reactor Regulation

cc: BWRVIP Service List

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