Supplemental Request for Information on GE's Response to ESBWR RAI Letter #31 (MFN 06-301)

RAI 21.6-4

This request asked General Electric (GE) to provide additional information on the depressurization operations during an Anticipated Transient Without Scram (ATWS). The staff finds the information that GE submitted in relation to Phenomena Identification and Ranking Table (PIRT) ranking and models contained within TRACG for simulating depressurization during an ATWS complete for review. However, GE has not submitted any demonstration calculations of this event. Before the staff approves TRACG's capability of performing this calculation, it would need for GE to submit some demonstration calculations. GE indicated that Emergency Operating Procedures (EOPs) have not been established at this time to instruct an operator to depressurize during an ATWS event. Therefore the staff does not find it necessary to approve this function of TRACG to support the ESBWR design certification. Should EOPs be established that instruct the operators to depressurize during an ATWS event, the staff would like to evaluate TRACG demonstration calculations at that time to ensure TRACG's capability of simulating the event. If GE requests approval of this capability of TRACG at this time, GE will need to submit demonstration calculations of this event.

RAI 21.6-12

In this request, the staff asked GE to explain how the time dependent FILL table was created for the TRACG model of the Standby Liquid Control System (SLCS) injection during an ATWS. GE gave the equations for which the table was developed. The staff has identified a possible error in the equation for $V_{j+1.}$ The term inside of the second square root is a difference in pressures (i.e. between accumulator gas space pressure and RPV pressure) and includes the difference in gravity head between the RPV and the accumulator. If the units for the term $h_0*\rho/144$ are correct, then units for $H_j/144$ are in error. h_0 is an elevation usually measured in feet and H_j is a Reactor Pressure Vessel (RPV) water level which is probably in feet. However, in order for these two terms to be consistent there must be a density included with H_j term (i.e. $H_j*\rho_j/144$). Does H_j already include a density? According to the RAI response it's a water level which is typically in units of length. The staff would like for GE to address this possible error.

In addition, the staff requests that GE justify their selection for the effective k loss in this equation. What is the uncertainty in the effective k loss for the accumulator line and nozzles? Given that uncertainty, what is the uncertainty in SLCS injection velocity? A perturbation of 10% in the SLCS injection velocity does not impact the suppression pool temperature; however does a perturbation of 10% bound the uncertainty associated with this model?

NRC Staff Supplemental Request for Information on GE's Response to ESBWR RAI Letter #31 (MFN 06-232)

RAI 21.6-39

The staff is concerned about GE's methodology as applied to non-isolation ATWS events since it appears that many of GE's design and modeling choices, and assumptions were based on the a failure to scram during an isolation event. GE predicts that during an isolation ATWS event, such as MSIV closure ATWS, the natural circulation patterns will develop such that the periphery of the core will be in down-flow and the center of the core will be in up-flow. Hence, GE selected the injection of the SLCS to be in the periphery core bypass. It would follow that the boron would flow down through the periphery bypass and then up through the channels as it moves to the center of the core. However during a non-isolation ATWS, these natural circulation patterns may not develop. There may be up-flow in the core periphery bypass causing the boron to flow up, in which case its mixing and transport time to get into the center channels is not as well established. The staff requests GE provide a discussion on how boron enters the core during a non-isolation ATWS. GE should describe the flow paths. GE should also discuss the nodalization and flow blocking selected, and justify that it has been demonstrated to be conservative during non-isolation ATWS events, including depressurization (if needed, see comment on RAI response 21.6-4).

NRC Staff Supplemental Request for Information on GE's Response to ESBWR RAI Letter #31 (MFN 06-324)

21.6-44

This RAI is related to qualification of the boron mixing model in TRACG. The staff needs additional information to determine that the test cited is applicable to ESBWR conditions. The staff is concerned that there is no test data to verify the mixing behavior of the SLCS system as injected into the core bypass. The tests cited to be applicable to the ESBWR are those where the boron is injected through the HPCS sparger for a scaled BWR/5 and 6. The justification used is predicated on knowing the ESBWR boron flow path and that it is similar to that of the HPCS sparger location. However this leads to a circular reasoning since the data is supposed to be used to inform the TRACG model that it is adequately calculating the boron mixing and flow paths in the core. Do you have any test data that verifies that injection of boron into the core bypass periphery will have mixing and flow paths similar to that of the HPCS sparger? In the RAI response, the scaling was only performed for the radial and axial directions and not as rigorous as that was done for the SBWR where you scaled such parameters as boron injection concentration, temperatures, loss coefficients, etc. Please provide a more rigorous scaling analysis. In addition, comparing the mixing tests to the ESBWR MSIV closure ATWS event seems awkward. The ESBWR MSIV closure ATWS event is so dissimilar to the experiment that a direct comparison would be difficult. Are there any comparisons using a TRACG04 input deck of the same experiment? The staff would like additional information about the test conditions. Please provide the following reference used in the RAI response: "Test Report Three-Dimensional Boron Mixing Model," General Electric Co., Proprietary Information, NEDE-22267, Class III, October 1982 (RAI response reference 21.6-44-3).