Non-Proprietary Request for Additional Information (RAI)
ESBWR Pre-Application Review
General Electric Company

RAIs related to NEDC-33083P, "TRACG Application For ESBWR"

It has been indicated that the ESBWR core would never be uncovered during a loss-of-coolant accident (LOCA) since the two-phase water level is always above the top of active fuel region. The staff performed a confirmatory analysis using TRACG V4.0 and gravity-driven cooling system (GDCS)/LOCA input deck provided by General Electric (GE). The calculated results show that the hot channel, which is modeled by CHAN0011, experiences high void fraction flow for a period of 30 seconds starting from 400 seconds into the GDCS/LOCA event. The maximum channel inlet and outlet void fractions are 0.96 and 0.98 respectively, while the void fraction in the heated region is about 93 percent. Therefore, part of the core is uncovered for a short period of time. A tele-conference was held on July 29, 2003, between the NRC staff and GE representatives regarding this issue. The following are GE's verbal positions:

- GE also predicted the same high void flow using TRACG V4.0 code for the GDCS/LOCA case.

- GE believes that [[ ]] no dryout would occur during the blowdown.

- GE believes that [[ ]] This is no different from operating BWR LOCA phenomenon.

- GE indicated that [[ ]] However, [[ ]] during the blow-down phase.

- GE believes that the TRACG code has the capability to predict critical heat flux for high void flow in the core and the [[ ]] the boiling transition.

- GE believes that the ESBWR fuel rod surface will not experience boiling transition [[ ]] occurs during the blowdown.

The staff requests GE to respond to the following questions and provide necessary justifications and technical basis:

406. Three LOCA cases have been analyzed by GE so far. They are the GDCS Line LOCA, Main Steam Line LOCA and bottom drain line LOCA. Please calculate the duration of the hot channel high void flow for all three cases using conservative approaches, i.e., 102 percent initial power level, delayed scram, 2σ uncertainty for correlations leading to a higher void fraction and a longer duration of high void flow, hot channel bundle power peaking factors, etc. Please model the chimney partition above the hot channel appropriately.

407. What is the uncertainty of the [[ ]]? Please calculate the hot channel departure from nuclear boiling ratio (DNBR) through out the entire high void flow condition and demonstrate that adequate margin exists. Please provide justification that the current DNBR calculation is conservative enough to ignore any sub-channel flow effects.

408. What is the basis to define the hot channel power peaking factor as [[ ]]? Have any sensitivity analyses been performed to address the impact of the axial power shape and hot rod power peaking factor? If so, please provide the results of the sensitivity analyses.

RAIs regarding GE Topical Report, GEFR-00850, "Simplified Boiling Water Reactor (SBWR) Program Gravity-Driven Cooling System (GDCS) Integrated System Test – Final Report"

409. General Electric (GE) topical report, GEFR-00850**,** is dated October 1989. The TRACG code has undergone changes since that time. Please confirm that the TRACG results presented in this report will be replaced by relevant analyses performed with the code version to be used for ESBWR design analysis.

410. GE topical report NEDC-33079P, "ESBWR Test and Analysis Program Description (TAPD)," list phenomenon [[ ]] as a medium ranked phenomenon that is covered by the GIST test data for validation of TRACG. The percolation phenomenon that occurred during the main steam line break test [[ ]] was apparently not predicted by the version of TRACG used at that time. Section 4.3.3.1 of the TAPD report offers this as an explanation of the differences in depressurization predictions. While [[ ]] would not be expected to be as important for the ESBWR design, compared to the GIST facility, due to the presence of steam separators and dryers in the ESBWR, it is nevertheless listed as a medium ranked phenomenon in the phenomenon identification and ranking table (PIRT). As such, one would expect TRACG to be assessed to predict [[ ]] . Does the version of TRACG to be used for ESBWR design analysis correctly predict the [[ ]]? If the GIST data are used to assess TRACG for [[ ]], do the important dimensionless groups (e.g. Weber Number, Reynolds Number) cover the range of the ESBWR? If the GIST data are not used, what data are used for TRACG assessment for this medium ranked phenomenon?

411. The TAPD report lists a number of phenomena (E8 – break flow, E1 – break uncovery, E3 – cold water injection below the 2-phase level, E7 – cold water injection above the 2-phase level) related to the GDCS line break flow where assessment data are provided by the GIST tests. [[ ]] Please explain how this limitation of the GIST data is addressed in the TRACG assessment.

412. Section A-3.1.4.1 of the TAPD report states how the GIST facility is vertically scaled [[ ]] with SBWR, but this appears not to be the same for ESBWR. The electrically heated rods that model the fuel in GIST are [[ ]] whereas the ESBWR fuel rods are [[ ]]. How is this difference in vertical dimension handled in using the GIST data to assess models for ESBWR applications?

413. Void distribution in the core region is correctly not included as phenomena that the GIST data cover. The presence of non-prototypical cold surfaces next to every heater rod will tend to increase liquid flow through the rod bundle to the upper plenum. Phenomenon F1, void distribution/2-phase level in the chimney and upper plenum, will be affected by the larger amount of liquid entering this region. How is this addressed when these data are used for TRACG assessment of upper plenum/chimney void distribution?