REQUEST FOR ADDITIONAL INFORMATION 707-5556 REVISION 2

3/1/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

SRP Section: 19 - Probabilistic Risk Assessment and Severe Accident Evaluation
Application Section: 19.2

QUESTIONS for PRA Licensing, Operations Support and Maintenance Branch 2 (ESBWR/ABWR Projects) (SPLB)

19-499

The US-APWR PRA report includes an equipment survivability assessment that considers electrical and mechanical instruments and equipment required for severe accident management. The applicant classified the time frames for equipment survivability, selected the necessary equipment and instruments, analyzed severe accident environments, and finally assessed equipment survivability.
The time frames for equipment survivability are classified in accordance with the characteristic stages of the severe accident progression. The time frames are as follows:

- T0: before the core has uncovered, the reactor core is intact and the environmental conditions in the containment are within the envelope of the DBA conditions.
- T1: from core uncovered to core damage, the reactor core is overheated and hydrogen generation starts due to cladding-water interaction. However, the environmental conditions in the containment are almost the same as in T0.
- T2: from core damage to reactor vessel failure, fission products are released from fuel to RCS and hydrogen is rapidly generated. The decay heat and oxidation heat promote the core degradation. Consequently core material relocates to the lower plenum if water is not properly injected into the reactor vessel. However, the environmental conditions in the containment are not harsh, i.e. the containment pressure at vessel failure is likely to be below the design pressure regardless of the containment cooling system condition. On the other hand, hydrogen release to the containment atmosphere is very likely in this time frame.
- T3: after reactor vessel failure, rapid hydrogen generation is expected to proceed immediately after the reactor vessel failure because un-oxidized metal in molten core reacts with water in the reactor cavity. After this transient oxidation event, hydrogen may be continuously generated due to MCCI, although further rapid hydrogen generation is unlikely. Hydrogen generation from MCCI occurs if reactor cavity is not flooded. The reactor cavity is flooded, and hence the possibility of MCCI is considered low. The environmental conditions in the containment for this time frame are maintained stable as long as containment heat removal is successful, regardless of hydrogen combustion by igniters. If containment heat removal is not achieved, harsh conditions for equipment are anticipated, mostly governed by pressurization and corresponding temperature rise. Influence by hydrogen combustion is considered insignificant.

The equipment survivability assessment only considered devices, systems or properties needed in time frames T2 or T3 that would be located either in the RCS or inside containment. The equipment and instruments necessary to function in each time frame

are tabulated in Tables 15-23 and 15-24 of the US-APWR PRA. Thirteen countermeasures against severe accidents are also identified in the tables and described in the PRA.
This information is judged by the staff as important enough to be included in the DCD. Accordingly, please include in the DCD a description of the countermeasures and the time frames when they would be used. Also, please include the material in Tables 15-23 and 15-24, and discuss the relevant information regarding necessary devices, systems, and physical properties, and where each would be located.