REQUEST FOR ADDITIONAL INFORMATION
US-APWR TOPICAL REPORT: SMALL BREAK LOCA METHODOLOGY, MUAP-07013-P (R0)

11/17/2009
Mitsubishi Heavy Industries
Docket No. 52-021
SRSB Branch

The following are NRC requests for additional information (RAIs) based on the review of the Small Break LOCA Methodology Topical Report. If there is a related RAI that was responded to earlier, that RAI is referenced in the "Original Question Number" column. This is the fourth set of RAIs on MUAP-07013-P(R0).

New Question Number	Original Question Number	Question
4-18	4-1, 4-13	[(Proprietary information withheld under 10 CFR 2.390)]
*6-7	6-4	[(Proprietary information withheld under 10 CFR 2.390)]
*7-23	7-14	Fig RAI-7-14.15, 16 and especially 18 of the July response (UAP-HF-09362) show very large and rapid oscillations in the vessel, including the core, flows. This raises the question about whether these flow oscillations promote core cooling. Appendix K, Section C.7.a on Core Flow Distribution During Blowdown" requires that "The calculated flow shall be smoothed to eliminate any calculated rapid oscillations (period less than 0.1 seconds). Discuss the manner in which this Appendix K requirement is satisfied.
*8.1.2-14	8.1.2-13	The explanation provided in the July response (UAP-HF-09362) is difficult to follow and needs to be made more concise to directly respond to the question. The presence of significant uncertainties in the experimental data is known, although the ±260 K outlet temperature uncertainty quoted on page 44 does not appear to be correct. Address concisely the effect of the uncertainty on the code validation.

* 60 day response time

8.1.4-10	8.1.4-9	The results shown in Figure RAI-8.1.4-9.1 indicate some pressure dependency in the range from 3 to 15 bar. As stated in the response, the important pressure range for use of this CCFL correlation is around 80 bar. This indicates that there could be considerable uncertainty in using this correlation at 80 bar based on the comparison to data at 3 and 15 bar. Describe how this uncertainty is addressed in the SBLOCA methodology.
8.3.1-1		In Section 8.3.1-4 it is stated that "The bypass path between the downcomer and upper head becomes an alternative steam flow path connecting the cold leg and the hot leg during the loop seal clearing period. Thus, the flow resistance of the path affects the core mixture level depression." Also in Section 8.3.1-5 it is stated that "A leak path between hot leg nozzles and the downcomer upper region becomes a steam flow path connecting the cold leg and the hot leg during the loop seal clearing period. Thus, the flow resistance of the path affects the core mixture level depression." As both of these flow paths can act to release steam from above the core during the loop seal clearing period, please explain how the uncertainty in the flow path area and the subsequent steam flow are treated in the SBLOCA methodology.
*8.3.1-2		[(Proprietary information withheld under 10 CFR 2.390)]

* 60 day response time

*8.3.1-3		Section 8.3.1.2 of MUAP-07013-P states that counter current liquid flow against the upward in-vessel flow of vapor is simulated in the M-RELAP5 model field equations, and cites the ORNL/THTF reflood separate effects test and the ROSA-IV/LSTF 5% SBLOCA integrated effects test as validation of the M-RELAP5 rewet simulation. Discuss whether the ORNL/THTF reflood separate effects test and the ROSA-IV/LSTF 5% SBLOCA integrated effects test provide validation of the in-vessel counter current flow component of the rewet simulation in M-RELAP5. Also, explain the relative contribution of liquid counter current flow heat transfer during rewet, and discuss the occurrence of counter current flow limitation during rewet.
*8.3.1-4		Section 8.3.1.1 states that the local power is modeled as the power distribution of the fuel rod in the axial and radial directions, and that it is defined by the input to the heat structure model. Describe how the 10CFR50 Appendix K requirements of maximum peaking factor allowed by Technical Specifications and worst combination of power distribution shape and peaking factor are implemented in the US APWR SBLOCA Evaluation Model, including a summary of the power distribution studies performed to arrive at the selected combination of peaking factor and power distribution shape that results in the most severe calculated consequences of the SBLOCA.
8.3.1-5		Section 8.3.1.2 states that the 3-D flow distribution can be determined by simulating the 3-D flow and heat transfer. US APWR DCD FSAR Section 15.6.5.3.1 describes the SBLOCA Evaluation Model as being one-dimensional. Clarify the application of 3-D modeling in the SBLOCA Evaluation Model.
8.3.1-6		Section 8.3.1.5 states that the M-RELAP5 mixture level tracking model can be used to refine the calculated mixture level in the upper plenum. Table 6.2.1-4 indicates that the mixture level tracking model is not utilized in the upper head and plenum regions of the SBLOCA Evaluation Model. Clarify whether the mixture level tracking model is used in the calculation of reactor vessel upper plenum mixture level in the SBLOCA Evaluation Model.

* 60 day response time

8.3.1-7		Section 8.3.1.7 states that the M-RELAP5 mixture level tracking model can be used to refine the calculated mixture level in the pressurizer. Table 6.2.1-4 indicates that the mixture level tracking model is not utilized in the pressurizer component of the SBLOCA Evaluation Model. Clarify the application of the M-RELAP5 mixture level tracking model to the pressurizer and pressurizer surge line volumes, including, if applicable, the conditions under which the model is applied and its effect on the calculated pressurizer mixture level.
8.3.1-8		[(Proprietary information withheld under 10 CFR 2.390)]
8.3.1-9		Section 8.3.1.9 states that the calculated loop seal mixture level can be refined using the M-RELAP5 mixture level tracking model. Table 6.2.1-4, however, does not indicate that the mixture level tracking model is used in the crossover leg. Clarify whether the mixture level tracking model is used in the calculation of loop seal mixture level in the SBLOCA Evaluation Model. Explain why the mixture level tracking model is / is not used to refine the loop seal mixture level calculation.
8.3.1-10		Section 8.3.1.13 states that the calculated vessel downcomer and lower plenum mixture level can be refined using the M-RELAP5 mixture level tracking model. Table 6.2.1-4, however, does not indicate that the mixture level tracking model is used in the downcomer and lower plenum vessel components. Clarify whether the mixture level tracking model is used in the calculation of downcomer and lower plenum mixture level in the SBLOCA Evaluation Model.

8.3.1-11		In Section 8.3.1.13, item 63, it is stated that the 1-D model is considered to give a conservative evaluation compared to the 3-D model because the liquid in the downcomer easily flows out to the break in the model. Justify this statement based on the code assessment results or other published materials.
*8.4.1-1		[(Proprietary information withheld under 10 CFR 2.390)]

* 60 day response time

		[(Proprietary information withheld under 10 CFR 2.390)]

* 60 day response time