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Date: 6/22/01 2:06PM
Subject: Observations and Questions on NRC PWR Sump Performance Research

Based on insights that industry obtained during the February meeting in Albuquerque, we've developed some observations and questions. These are provide to the NRC staff for its consideration and hopeful discussion during the July 26 and 27 public meeting on this topic.

By providing the NRC staff this information a month prior to the meeting, it is hoped that many of this questions and issues could be addressed in the NRC presentation material.

The Observations and Questions follow:

Observation 1:

At the public meeting held in Albuquerque, NM on February 14, 2001, the NRC invited industry to participate in a joint NRC / Industry coatings research program. The 4th slide of the presentation used by NRC to convey this invitation, titled, "What are the Major Findings", contains a table summarizing the test conditions under which coatings failures are reported to have been observed. One entry on that table, ASTM D3911 DBA curve w/ Water immersion, is reported to have resulted in coatings failures. Data available to date, including the SRTC test report, do not support this observation.

Question: Is this an error in the presentation? If it is not, when will data supporting this assertion be made available to industry for review?

Observation 2:

At the public meeting held in Albuquerque, NM on February 14, 2001, the PWR Owners Groups presented initial at-power dose survey results from plants. The survey showed that the total integrated dose rate at normal power operations at the end of 60 Effective Years of Full-Power operation are one to two orders of magnitude lower that those used in the coatings tests for which flocculent coatings debris was observed to have occurred. Calculations presented also showed that the accident dose calculated with all ECCS equipment assumed to operate as designed, are also one to two orders of magnitude lower than those used in the coatings tests for which flocculent coatings debris was observed to have occurred.

Question: How will NRC incorporate this data in their research?

Observation 3:

The flume testing already performed and documented provides significant information regarding both the transport and non-transport of debris. Specifically, from the date reported, it is possible to make observations that reflective metallic debris larger than a certain size and in a flow field less than a certain velocity was not observed to transport. Reporting data in this format is generally considered a good engineering practice, as

it helps to focus attention on items that affect the phenomena of interest. That is, if debris is not transported to the sump, it will not result in blockage, and is therefore not of interest in this case.

Question: When will NRC summarize this data in this format?

Observation 4:

In public meetings, NRC has stated that the purpose of both the flume test and the tank test is to develop a database to support the use of a CFD code. Specifically, the data is to be used to build and demonstrate the ability of debris transport models to predict debris mobility under conditions predicted to exist in PWR containment sumps post-accident.

Questions: What is the plan to verify the debris transport models? Please include information such as the range of velocities to be considered, how temperature-dependent viscosity will be addressed, range of specific gravities to be considered, and how variations in geometry will be addressed.

Observation 5:

Pressure drop (head loss) across the sump screen is dependent upon the debris bed that accumulates at the sump screen, the composition of the debris bed itself, and the geometry of the debris bed. From available information, it is unclear how NRC will study the effect of debris accumulation on the composition of the debris bed. That is, how much of what type of debris is transported to the sump screen, when are the components of the debris bed deposited at the sump screen, and what behavior do they exhibit once they are deposited on screen.

Question: How does NRC plan to address the prediction of debris accumulation on the fine-mesh sump screen?

Observation 6:

As noted above, pressure drop (head loss) across the sump screen is dependent upon the debris bed that accumulates at the sump screen, the composition of the debris bed itself, and the geometry of the debris bed. At the February 14, 2001 public meeting, NRC suggested that it might perform uniform debris layer pressure drop testing. From available information, it is unclear how such data can be meaningfully applied to the non-uniform debris bed build-up that might be expected with a PWR ECCS operating in the long-term (ECCS functioning in the recirculation mode).

Question: Please provide and explanation of how NRC will experimentally study pressure drop / head loss for PWR sump configurations. Should NRC choose to use a uniform debris bed approach, please also include an explanation of how the uniform debris bed information will be transposed to the geometry expected with the configuration typical of a PWR.

Observation 7:

At the February 14, 2001 public meeting, NRC used a schematic diagram to show the interrelationship among the various research activities performed under GSI-191. While the diagram shows there is a relationship between the various research elements, it does not provide significant information as to how that relationship will be accomplished.

Also at the February 14, 2001 public meeting, NRC identified that, based on flume and tank testing, curbs appeared to be a benefit to reducing or minimizing debris transport to the sump.

Question: How will the amount of debris generated from a break (zone of influence), transport time, curbs, and potential changes in velocity during transport be integrated in the total picture to determine head loss at the sump screen.

Observation 8:

NRC's probabilistic risk assessment models were initially presented at a March 2000 public meeting. At that meeting, the NRC contractor identified it was awaiting data from the experimental program to perform calculations. Also at that meeting, it was suggested that the models be exercised with a range of assumed inputs to learn how the models will perform, and to look for sensitive inputs to the calculations. With the model changes implemented following the peer review of the PRA work, the suggestion to exercise the model appears to be again appropriate.

Suggestion: It is again suggested that the PRA model(s) be exercised in advance of experimental data becoming available.

Observation 9:

The NRC's PRA model appears to be fairly sophisticated and complex. The PWR Owners Groups are interested in developing an understanding of the PRA model overall, and the sump sub-models specifically. This interest was expressed at the February 14, 2001 public meeting. NRC agreed to conduct a technical meeting with the PWR Owners Groups to review the PRA model(s).

Question: Has NRC given further consideration as to when this technical meeting might occur?

Observation 10:

At the February 14, 2001 public meeting, the NRC contractor indicated that, based on the peer review, the PRA would now include events other than design basis events.

Question: Please explain and provide some detail on what this means. For example:
1) What are the "other than design basis events?"
2) What is the basis for considering the "other than design basis events?"
3) For the "other than design basis events," are multiple failures now

included in the PRA?
4) What operator actions are included in the PRA?
5) What is the maximum and minimum break size included in the PRA?

Observation 11:

As noted above, at the February 14, 2001 public meeting, NRC used a schematic diagram to show the interrelationship among the various research activities performed under GSI-191. It was explained that the diagram is intended to show the relationship between the various research elements. In the diagram, a line with an arrow shows the item labeled "Sump Performance" as providing input to the item labeled "Risk Analysis." No complimentary relationship is shown; that is, there would appear to be no recognition or accounting of PRA insights in the other research activities performed in support of GSI-191.

Break size affects many parameters that are considered important to long-term post-accident sump performance. For example, break size affects zone of influence and zone of influence affects debris generation. Small breaks may allow the ECCS to maintain the reactor coolant system at an elevated pressure. This condition reduces the rate of flow drawn from the containment sump, which, in turn, reduces both the potential for debris transport to the sump, as well as the rate of debris accumulation on the fine-mesh sump screen.

Question: If break sizes other than double-ended guillotine breaks are included in the PRA, how will this be accounted for in the deterministic evaluation of debris generation, transport, accumulation on the fine-mesh sump screen and consequential head loss across the sump screen?

Observation 12:

Again, related to break sizes other than a double-ended guillotine and other non-design basis event, depending upon plant configuration and plant specific procedures, operator actions may be identified that vary from plant to plant. An example of this may be, for certain small break LOCA's, the shutting down of a low-pressure ECCS pump. This operator action will reduce the flow rate in containment, resulting in a reduced potential for transport and accumulation of debris on the fine-mesh sump screen.

Question: What operator actions, such as shutting down an ECCS pump, will the PRA consider? Will these be treated as the "standard" operator actions? If a "standard" set of operator actions will be identified, how will the PRA consider variations to that "standard" set of operator actions?

Observation 13:

At the February 14, 2001 public meeting, the NRC contractor indicated that the PRA event tree would model the sump performance as either a "successful" or "unsuccessful" event with a one-zero probability. That is, for a given accident, the sump is taken to either function, or it fails to function. This modeling is a "pass / fail" criteria.

Question: This understanding raises several questions or concerns:

1) What is the success criteria that NRC will use to determine "successful / unsuccessful" sump operation?

2) What is the basis for the success criteria that NRC will use? Is it based on experimental data, analytical models or a combination of the two?

3) Will the criteria consider ECCS operation with degraded NPSH available? If "yes," how will this operation be accounted for? If "no," please share the rationale for that decision.

Observation 14:

At the February 14, 2001 public meeting, the PWR Owners Groups proposed NRC and their contractor consider information developed by industry and previously reviewed and approved by NRC for use on other issues. Specific topics identified were break opening time and initiating event frequencies. The PWR Owners groups suggested that information developed in these areas might be used in both debris generation testing and NRC's PRA, and also asked NRC to provide feedback as to how this information would be dispositioned within the GSI-191 research effort.

Question: Has NRC and / or their contractor considered how industry-generated information might be used in GSI-191 research activities. If a decision was made to not include or take advantage of this information, when will NRC provide a rationale for that decision? If NRC has chosen to use this information, how may industry further assist in using this and other data developed by industry?

I will call you, so that we can discuss this request further.

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