

## Questions for NISA regarding ECCS Sump Performance

### **Destruction ZOI/Debris Generation questions**

1. Has NISA performed or have access to test results or engineering models evaluating the destruction zones from a 2-phase jet? If so, could this information be provided?
2. Has NISA performed or have access to test results or engineering models evaluating the destruction pressures for various types of commonly used insulations? If so, could this information be provided?
3. Has NISA performed or have access to test results or engineering models evaluating the destruction pressures for different types of insulation jacketing (example: double jacketing insulation with seams in opposite directions, double banding insulation with banding links in opposite directions)? If so, could this information be provided?
4. Does NISA have a database or tabulation of plant walkdown data indicating types and amounts of insulation material, ECCS flowrates, ECCS screen area, Containment pool velocity, and current NPSH margin? If so, could this information be provided?

### **Coatings questions**

1. Has NISA performed or have access to test results or engineering models evaluating the destruction pressures for various types of commonly used protective coatings? If so, could this information be provided?
2. Has NISA performed or have access to test results or engineering models evaluating the size distribution for various types of commonly used protective coatings (example: fail as delaminated chips or particulates, size distribution)? If so, could this information be provided?
3. Has NISA performed or have access to test results or engineering models evaluating the physical characteristics (tendency to curl, specific density, etc.) for various types of commonly used protective coatings? If so, could this information be provided?
4. Has NISA performed or have access to test results or engineering models evaluating the transportability of various types of commonly used protective coatings? If so, could this information be provided?
5. Has NISA performed or have access to test results or engineering models evaluating the contribution of ECCS strainer head loss for various types of commonly used protective coatings? (Also need to include any assumption or

qualification for overlap/distribution of paint chips on the ECCS strainer) If so, could this information be provided?

6. Has NISA performed or have access to test results or engineering models evaluating the failure rates and failure mechanisms of qualified vs. unqualified protective coatings? (Need to include criteria for distinguishing between qualified and non-qualified coatings) If so, could this information be provided?

### **Debris Transport questions**

1. Has NISA performed or have access to test results or engineering models evaluating the hydro-dynamic behavior of BWR Suppression Pools (pool swell, chugging, condensation oscillation) and PWR Containment Pools (pool velocities, turbulence levels)? If so, could this information be provided?
2. Has NISA performed or have access to Computational Fluid Dynamic evaluations of upper containment areas in PWR's? If so, could this information be provided?
3. Has NISA performed or have access to test results or engineering models evaluating the transport of various types and sizes of debris expected in containment post-LOCA? If so, could this information be provided?
4. Has NISA performed or have access to test results or engineering models evaluating the erosion of large pieces of debris in the spray zone and flooded pool zone of containment post-LOCA? If so, could this information be provided?

### **Head Loss questions**

1. Has NISA performed or have access to test results or engineering models evaluating the calculated head loss across an ECCS strainer with NRC NUREG/CR-6224? If so, could this information be provided?
2. Has NISA performed or have access to ECCS strainer head loss testing for Calcium Silicate insulation? If so, could this information be provided?
3. Has NISA performed or have access to test results or engineering models evaluating the head loss across complex strainer designs (particularly head loss associated with Thin Bed behavior and Calcium Silicate insulation)? If so, could this information be provided?
4. Has NISA performed or have access to test results or engineering models that indicate that it is not feasible to create a uniform Thin Bed on a complex strainer? If so, could this information be provided?

5. Has NISA performed or have access to test results or engineering models that indicate that at very low approach velocities, mixed debris beds will not compress or compact enough to create significant head loss across the ECCS strainer? If so, could this information be provided?
6. Has NISA performed or have access to test results or engineering models for evaluation of unique (ex. fiber-bed coated strainer, self-actuating active strainers, etc.) strainer design? If so, could this information be provided?

### **Downstream Effects questions**

1. Has NISA performed or have access to test results or engineering models evaluating the amount and types of debris that can be expected to penetrate a clean and debris laden ECCS screen? If so, could this information be provided?
2. Has NISA performed or have access to test results or engineering models evaluating the performance of ECCS pump and valve subcomponents (wear rings, bearings, seals, cyclone separators, impellers, etc.) under debris laden working fluid environments? If so, could this information be provided?
3. Has NISA performed or have access to test results or engineering models evaluating the potential for debris laden ECCS water to clog reactor fuel nozzles, channels, or grids? If so, could this information be provided?

### **Chemical Effects questions**

1. Has NISA performed or have access to test results evaluating the potential for typical nuclear power plant materials (insulations, structural materials, component materials, coatings, spray additives, etc.) to interact chemically in a normal post-LOCA environment to produce materials (gels or particulates) that could result in additional loading of ECCS screens? If so, could this information be provided?
2. If chemical interaction testing has been performed, does the data indicate a significant time or temperature dependency? If so, could this information be provided?
3. Has NISA performed or have access to test results or engineering models evaluating the potential for these chemical by-products to produce an excessive head loss on a clean or debris laden ECCS screen? If so, could this information be provided?

### **Industry Experience questions**

1. Has the Mihama event been investigated and evaluated to provide data that would support evaluation of ECCS sump strainer issues? This would include evaluation and documentation of the following items:
  - Fluid thermal-hydraulic conditions inside the pipe before rupture – pressure, temperature
  - Insulation material on the ruptured pipe
  - Amount of insulation damaged – both on ruptured pipe and surrounding pipe insulation
  - Characterization of insulation damaged – large pieces, small fines, blanket moved intact, etc...
  - How large was the area of damage in comparison to the fluid thermal-hydraulic conditions
  - Does there appear to be a difference in damage between the area effected by the two-phase jet than the surrounding area (or if evaluating multiple breaks, a difference between a feedwater, wet steam, saturated steam, or superheated steam break)
  - Were any surrounding coatings damaged? If so, where were they located in relation to the jet?
  - How much of the debris created from the break was transported outside the immediate area? What transport mechanisms are relevant?
  - Are there pictures available for evaluation?
2. Have other pipe rupture events been investigated and evaluated to provide data that would support evaluation of ECCS sump strainer issues? (This could also include fossil stations, even super-critical station events)
3. Is BWR Suppression Pool cleanliness monitored? Is this data collected and evaluated in a programmatic way?
4. What models and engineering evaluation tools are used to evaluate BWR Suppression Pool hydro-dynamic conditions and loads?
5. Has NISA considered or evaluated the use of Interim Compensatory Measures to reduce risk from the potential of ECCS strainer blockage? (Example: change operator response during a LOCA to throttle or secure excess ECCS injection at the onset of Recirculation operations) If so, what was used and how was it implemented?

#### **Alternate Evaluation questions**

1. Are any plants considering application of a risk-informed approach for resolving the ECCS strainer blockage issue? If so, provide information regarding any risk-based activities being used.