Mail Pc? Meeting 7/18/2000

STATEMENTS FROM APPENDIX 1 THAT CAN BE USED OUT OF CONTEXT TO DISCREDIT SFP RISK ASSESSMENT

1. Line 30 - "Even if the fuel does not undergo runaway oxidation it can not be allowed to stay at high temperatures for an indefinite period of time...will eventually lead to the loss of cladding integrity. This may allow the fuel pellets to cause flow blockages and/or release fission products and fuel fines..."

2. Line 36 - "The melting temperature of aluminum, which is a constituent in BORAL poison plates...is approximately 640 °C ... Molten aluminum can also dissolve stainless steel or zirconium...[M]elting and relocation...may cause flow blockages...No realistic evaluation of melting and relocation of aluminum, aluminum/boron carbide eutectic, or intermetallic mixtures has been performed."

3. Line 45 - "Another concern is the structural integrity of the fuel racks at high temperatures... The steel racks may not be able to maintain structural integrity... Loss of integrity may affect the propagation of a zirconium fire."

4. Line 55 - "...the spent fuel cladding temperature must be kept below 565 °C."

5. Line 100 - "The SFUEL series of codes did not mechanistically model melting and relocation of materials.."

6. Line 117 - "A critical decay time for high-density BWR racks was not provided due to code limitations."

7. Line 127 - "... [T]he BWR critical decay time for current burnups and rack designs would now be longer than the SNL estimate for high-density PWR racks.

8. Line 139 - "...it is the opinion of the staff that [studies in support of GSI 82] do not provide an adequate basis for exemptions."

9. Line 140 - "...[The GSI 82 studies] lack sufficient information for *all* the parameters that could affect the decay time... results [from the studies] may not be directly applicable to today's spent fuel."

10. Lines 71, 73, and 143 - "The SFUEL code has undergone very little assessment....[The] new computer code, SHARP, ...was built on the assumptions used by SNL and BNL in [SFUEL and SFUEL1W] in support of GSI 82.

11. Line 146 - The calculated decay time values [from SFUEL series codes] do not represent current plant operational and storage practices."

12. Line 154 - "SHARP lacks models for radiation heat transfer, zirconium oxidation, and materials melting and relocating...grid spacer losses, and neglects mixing between the rising hot air and the falling cooler air in the SFP."

13. Line 163 - "Current fuel burnups in some plants...have increased to values higher than those used by BNL [in SHARP] and perfect ventilation was assumed, which could lead to an underestimation of the critical decay times.

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14. Line 165 - "The SHARP code was not significantly benchmarked, validated, or verified."

15. Line 170 - "The staff has identified several areas that require code modifications, which will increase the calculated critical decay times. [SHARP] is not adequate for use as a technical bases by licensees."

16. Line 182 - "Many assumption and modeling deficiencies exist in the current calculations."

17. Line 186 - "Calculations performed to date assume that the building, fuel, and rack geometry remain intact...Rack integrity may not be a good assumption after onset of significant zirconium oxidation...Assuming that the racks remain intact is the most optimistic assumption that can be made about the rack geometry. Any damage tot he racks or the building could significantly reduce the coolability of the fuel."

18. Line 193 - "Previous SFUEL, SFUEL1W, and SHARP calculations ... used a perfect ventilation assumption."

19. Line 204 - "Sensitivity studies have shown that heatup rates increase with decreasing ventilation flow. ... Zirconium-Nitrogen reaction modeling is not included in the SFUEL code and may have an impact on zero and low ventilation cases."

20. Line 215, 224 - "The calculated airflow and peak temperatures are very sensitive to the flow resistance in the storage racks, fuel bundles, and downcomer. SFUEL and SHARP calculations have neglected the losses from the grid spacers, intermediate flow mixers, and the tie plates...[I]nclusion of this additional flow resistance may extend the critical decay time...the largest source of uncertainty was due to the natural circulation flow rates."

21. Line 229, 234 - "The downcomer and bundle inlet air temperatures and mass flow rates are important in determining the peak cladding temperature... FLUENT calculations performed by RES indicate that fully 3-dimensional calculations are needed to accurately predict the mixing and flow fields..."

22. Line 248, 255 - "Radiation heat transfer is important in spent fuel pool heatup calculations. Radiation heat transfer can affect both the onset of a zirconium fire and propagation of a fire...SFUEL calculations... included radiation heat transfer, but the radiation heat transfer was under predicted."

23. Line 270, 274 - "Extrapolation of the decay heat calculations... indicate that approximately 3 years will be needed to reach a decay heat of 6 kW/MTU.... The critical decay heat may actually be less than 3kW/MTU when in-bundle peaking effects, higher density rack configuration, and actual building ventilation flows are taken into account."

24. Line 284 - "It should be noted that none of the analysis codes have all of the required models or enough experimental assessment to be considered as properly qualified to analyze the spent fuel pool heatup problem."

25. Line 290, 344 - "When zirconium reaches temperatures where air oxidation is significant, the heat source is dominated by oxidation....The oxidation model used in SFUEL calculations does not contain the effect of breakaway oxidation."

26. Line 347, 353 - "The lower temperature limit for breakaway oxidation in zircaloy-2, zircaloy-4, or any advanced zirconium alloy is unknown. The mechanisms that induce breakaway oxidation are unknown at the present time."

27. Line 355 - "Fuel cladding can contain high concentrations of zirconium hydride at the oxide-cladding interface in high burnup fuel. The effect of zirconium hydride on cladding oxidation rates is unknown at this time....The effect of the hydrogen reaction product [from zirconium hydride oxidation] on the oxide film and oxidation rate is unknown. It is possible that cladding rupture at a temperature near 700 °C may lead to autoignition of the cladding..."

28. Lines 373, 376 - The BNL and SNL studies in support of GI 82 represented operating practices of the 1980's... underestimate peak burnup values. The decay heat at the same burnup level used in the SHARP analysis is significantly lower than that used in the SFUEL analysis. Given that burnup is an important parameter for determining critical decay time, this is a significant change."

29. Line 398 - "The amount of heat removal [from the fuel] is dependent on several variables...that are difficult to represent generically without making a number of assumptions that may be difficult to confirm on a plant- and event-specific basis."

30. Line 414 - "The staff has also considered a scenario with a rapid partial draindown to a level at or below the top of active fuel with a slow boiloff of water after the draindown...For the worst case draindown ...the heatup time is slightly less than the heatup time for the corresponding air cooled case."

31. Line 436, 457 - "FLUENT calculations show that the critical decay heat is less than 3 kW/MTU for the pool and building configuration that was studied at a building ventilation rate of 2 building volumes per hour. The staff estimates it will take approximately 5 years to reach a decay heat less than 3 kW/MTU for current BWR plant fuel and approximately 7 years for current PWR fuel burnups. [However], since the building ventilation rate may be close to zero after [a seismic event],... the critical decay time could be extended indefinitely."

32. Line 461 - "Spent fuel pool reracks have continuously increased the fuel power density and decreased the downflow area available for cooling flow. Since the design basis for spent fuel pools involves water cooling only, no restrictions have been put on parameters that increase severe accident risk. Recent reracks have left as little as 2 inches of downcomer width available for downflow. The downcomer width assumption was approximately 6 inches in the FLUENT calculations."

33. Line 469 - The staff has not performed a sufficient amount of research to fully understand and predict the propagation of zirconium fires in a spent fuel pool."

34. Line 470 - Propagation [of a zirconium fire] is probably limited to less than 2 full cores at a time of 1 year after shutdown...This does not consider potentially important effects such as rubble formation after loss of fuel integrity."

35. Line 479 - "The staff has concluded that it is not possible to perform a generically applicable analysis to determine heatup times or critical decay times."

36. Line 483 - "The staff...has a poor understanding of the accident progression and source term from a spent fuel pool fire."

37. Line 489 - "A realistic accident scenario for the dominant risk sequence or a number of scenarios with associated probabilities should be defined."