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Subject: summary of issues attached

Q1194

Summary of Issues/Problems for Spent Fuel Pool Decommissioning

Breakaway Oxidation / Hydriding / Fuel Fines Effect on 10 Hour Delay and Critical Decay Time

Breakaway oxidation occurs when the oxide layer cracks or breaks away leaving exposed a thin stable layer of ZrO_2. The thin stable layer can range from 2-20 microns in thickness. The limited experimental data shows that breakaway oxidation may occur for exposure times longer than 60 minutes. The impact of breakaway oxidation was studied by transforming the parabolic oxidation rate equation into a linear oxidation rate equation for a constant oxide layer thickness. The oxidation rate is limited by the diffusion of oxygen through the oxide layer. Parabolic kinetics is equivalent to a oxide layer growing in time. Linear kinetics is equivalent to a constant thickness oxide layer. Calculations performed using a constant oxide layer thickness of 2 microns have a significant impact on the heatup times and the critical decay time.

Rapid clad ballooning and rupture that occurs at 700 C can lead to local autoignition of the cladding due the exposure of bare zirconium hydride and /or zirconium metal to an air environment. The reaction rate will be far greater than the reaction rate with a protective oxide layer. The propagation of the reaction is not known.

Accepting the possible release of fuel fines and associated fission products (Ruthenium) as an acceptance criteria will lower the maximum cladding temperature to approximately 600 C. This will extend the critical decay time and decrease the time to fission product release.

Building Ventilation Effect on 10 Hour Delay and Critical Decay Time

All calculations performed to date to determine a critical decay time and the heatup time to fission product release used either a perfect (infinite) ventilation assumption (GSI-82) or a nominal building ventilation flow rate of 2 building volumes per hour along with an intact fuel rack geometry. The ventilation assumption has long been known to have a substantial impact on the heatup calculations. Reducing the ventilation flow rate will increase the heatup rate and also increase the critical decay time. The heatup time to a fission product release can be significantly less than 10 hours and the critical decay time can be extended well beyond 5 years by lowering the building ventilation flow rate. The assumed building ventilation rates are not defensible since the accident initiator is a well beyond design basis seismic event. The intact rack geometry assumption is also not defensible since it is not unlikely that part of the building may collapse onto the fuel racks.

Partial Draindown Scenario

Present calculations show that a partial draindown can result in cladding temperatures well above the threshhold for fission product release at 5 years after shutdown. The partial draindown scenario may also cause the time to fission product release to be significantly less than 10 hours at 1 year.

Conclusions

The time to fission product release can be significantly less than 10 hours at 1 year and there is no well defined critical dacay time beyond which a substantial fission product release can not occur.