DEFENSE NUCLEAR FACILITIES SAFETY BOARD

May 29, 1998

MEMORANDUM FOR: G. W. Cunningham, Technical Director
FROM: J. Kent Fortenberry / Joe Sanders
SUBJECT: SRS Report for Week Ending May 29, 1998

Americium-Curium - An Independent Review Team chartered by DOE-SR to examine both technical and project management aspects of the Am/Cm project has issued an interim report on the technology options for Am/Cm stabilization. The team concluded that no single option could be recommended at this time and noted that the cylindrical induction melter (CIM) vitrification option still had a significant degree of technical risk requiring substantial development. The team recommended pursuit of three options for stabilization of Am-Cm: (1) continued development of the vitrification option, (2) an 'in-can' conversion to oxide, and (3) a 'fall back' option to dispose Am-Cm through the SRS high-level waste system. The Independent Review Team also observed that the Am/Cm project had suffered from insufficient planning and technical oversight, and recommended that technical oversight be strengthened and enhanced. WSRC plans to issue a response next week. The Independent Review Team will be conducting reviews through August.

Testing of the first bushing melter for Am-Cm stabilization began in September 1995, with expectations that the Am-Cm stabilization would be completed by 1998. In response to DNFSB observations regarding the absence of an R&D plan, and prompted by melter problems, WSRC issued an Am-Cm Vitrification Development Program Plan in November 1997. During the same month, DOE-SR and WSRC determined that the proposed Am-Cm vitrification system was too complex and unreliable. WSRC is now conducting R&D on the batch-fed, cylindrical induction melter. During a March 18, 1998 DNFSB video-conference, the Board pointed out significant development challenges with the cylindrical induction melter, including engineering the batch feeding of the oxalate precipitate, addressing issues associated with CO_2, CO, H_2O, and H_2 released during the oxalate decomposition, and demonstrating the adequacy of the open top melter offgas system. The Board also reiterated the need for a comprehensive R&D plan. Now, five months after abandoning the bushing melter design, WSRC has issued a revised Am-Cm Vitrification Development Program Plan. In general, the plan does not adequately define all of the issues that must be addressed, the milestones and schedules required for each issue, or adequate measures of success. As an example, the issues associated with batch feeding of the oxalate precipitate cake to the melter are addressed in the plan with the sentence "Development work is planned to determine the best means for draining the vessel, which will include vessel geometry, agitator design, wash decant amount, and flush amounts." Two related objectives listed for "Phase III" testing are "Evaluate effectiveness of the precipitator / slurry feed tube design for delivering wet oxalate feed to the melter vessel" and "Evaluate the ability to control the oxalate precipitate to frit feed ratio." The plan contains no additional details for focussing R&D on this challenge, no interim milestones, and no specific activities to be conducted.

Several items merit note related to the development efforts for the cylindrical induction melter. The melter temperature distribution is not as uniform as expected. The top 2.5 inches of the melter are cold and the bottom section is considerably hotter than the upper cylinder walls. WSRC is looking into design of the induction coils. In addition, an insulation cap is now being placed on top of the 'open top' melter to increase temperature at the top of the melter. A ramp-up of temperature prior to fully drying the oxalate resulted in expulsion of material out of the melter, prompting the installation of an 'in-melt' thermocouple to monitor the melt temperature.

Di-Butyl Phosphate (DBP) in Enriched Uranium (EU) Storage Tanks - EU solution from H-Canyon is stored as uranyl nitrate at 6 gm-U/liter (60% enriched). The criticality concentration limit is 11.5 gm-U/liter. Criticality controls also limit the amount of tri-butyl phosphate to prevent a possible extraction of enriched uranium into a tri-butyl phosphate layer.

Tri-butyl phosphate will degrade to di-butyl phosphate. The rate of degradation depends primarily on temperature, acidity, and radiation. Di-butyl phosphate degrades in turn to mono-butyl phospate and then to phosphate. Di-butyl phosphate can combine with uranium to form an insoluble compound. Previous assessments by SRTC indicated that uranium precipitation would not occur under nominal conditions as long as the di-butyl phosphate concentration was less than about 125 ppm. At that time, solution that had been stored for as much as eight years was determined to have a di-butyl phosphate concentration of only about 30 ppm. Although no authorization bases controls were implemented, the di-butyl phosphate concentration was monitored through analysis of periodic tank samples.

Recent planning to concentrate EU solutions from 6 gm-U/liter to about 10 gm-U/liter raised questions about whether the resulting di-butyl phosphate concentration could approach the 125 ppm limit. A New Information process was initiated December 1997 to explore the potential need for additional or new controls. Based on recent lab testing, SRTC has recommended a limit on di-butyl phosphate concentration of 86±2 ppm (based on 0°C, 12 gm-U/liter, and 0.5M HNO_3). This week WSRC declared a Potential Inadequacy in the Safety Analysis (PISA), which is expected to result in an Unreviewed Safety Question (USQ), to address the need for new and additional controls. The first likely action taken will be to increase the EU solution acidity from 0.1M to 0.5M nitric acid. Authorization Bases controls will be finalized to limit temperature (0°C), acidity (≥0.5M), and di-butyl phosphate concentration (≤80ppm). Existing EU solutions will be brought back into H-Canyon through 2nd cycle solvent extraction to remove di-butyl phosphate as well as other impurities (consistent with preparations for the HEU blenddown program). This purified EU solution will then be washed with n-paraffin to remove the residual tri-butyl phosphate. The solution will then be concentrated via an evaporator and returned to the outside facilities for storage.

DOE-SR Facility Representatives - The potential RIF last August showed that although the DOE-SR Facility Representative position would be preserved, individuals qualified as facility representatives would have no special protection. Qualified facility representatives would remain in their position during a RIF only if they had sufficient ‘seniority’ in the federal service, and it was possible that some qualified facility representatives could be replaced with new incumbents needing a considerable amount of training. This week, the FR Position Descriptions were revised resulting in 33 “Designated” Facility Representative positions. This will help ensure that a significant number of highly trained and capable facility representatives are not suddenly replaced during a RIF. Seven DOE-SR Facility Representatives remain “Non-Designated” positions.