VITRIFICATION 1998: A PROGRAM IN TRANSITION ACROSS THE DOE COMPLEX

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ABSTRACT

The United States Department of Energy (DOE) high-level waste (HLW) vitrification program has made significant transitions to new phases at all three facilities during the past year. The West Valley Demonstration Project (WVDP) has completed Phase I of their vitrification campaign; the Savannah River Plant (Defense Waste Processing Facility, DWPF) continues its safe operations and is currently evaluating alternative methods of treatment for the salt feed at the Savannah River Site and decisions have been made at Hanford for the next steps in the privatization of the treatment of HLW.

Since June 1996, the WVDP has produced more than 230 canisters of glass, immobilizing more than 200 tons of HLW. The milestone for completing Phase I was met June 10, 1998, about three weeks ahead of schedule. Expected production rates (about three canisters per week) and plant availability (about a 75% rate) were maintained through the end of the campaign. With more than 90% of the curies removed, the project is now designing state-of-the-art equipment for final clean-out of the waste tanks. Innovative technologies will be developed and used for final HLW removal from the tanks.

In March 1996, DWPF became the first plant in the U. S. to vitrify HLW. After decades of planning and laboratory and pilot scale testing, the facility is now producing approximately three-quarters of a canister of glass per day. New methodologies are being evaluated to replace the In-Tank Precipitation (ITP) process for pretreating the salt feed to DWPF.

At Hanford, the Secretary has decided to privatize the pretreatment and immobilization of the High Level Waste contained in the 177 tanks. In August 1998, BNFL, Inc. was awarded a two-part contract worth approximately $6.9 billion for the immobilization of about 10% of the mass, or 20-25% of the radioactivity in Hanford's 54 million gallons of waste by 2018. The initial part of the project is a 24-month design phase that will result in private financing closure, regulatory permit applications, readiness to begin construction, final fixed-unit prices for treated waste, and a firm schedule for cleanup to occur. The second part of the contract will provide for the construction of the facilities, followed by treatment and immobilization of the waste contained in the tanks at a fixed-price.

With the continued successful operation of two vitrification facilities and the successful placement of the contract for Hanford HLW, the DOE has taken several more important steps in

safely reducing the risks associated with the waste produced in support of national security requirements.

WEST VALLEY DEMONSTRATION PROJECT

Since June 1996, the WVDP has produced more than 230 canisters of glass, immobilizing more than 200 tons of HLW. Since meeting the milestone for completing Phase I on June 10, 1998, production rates have slowed and the emphasis has shifted from waste form production to waste tank clean-up. The heel of the main waste tank (8D-2) is now being flushed with water and combined with the zeolite materials remaining in the spare tank (8D-1).

Several new technologies are being examined. Initial emphasis will be on mechanical removal of materials. Under development is remotely operated equipment that must be able to position and maneuver various tools and equipment to perform waste retrieval and cleaning within the tanks, such as visual inspection equipment, sluicing equipment, and waste removal equipment and tools for spraying and vacuuming. The equipment must work around 51 vertical columns within the tank and a structural gridwork approximately 3 feet above the tank floor.

Cleanup of waste tanks 8D-1 and 8D-2 presents a significant challenge due to their size, limited access through existing risers, high radiological activity and congestion from internal structural members. The ability to access all areas within the tanks is required. Tank 8D-1 contains radioactive zeolite, rust scale and liquids that must be transferred to tank 8D-2. Tank 8D-2 contains sludge, in addition to the waste of 8D-1. Retrieved waste from tank 8D-2 must be transferred to the vitrification facility for processing.

Also being examined is the use of oxalic acid to be used as a final chemical “polishing” of the tank. The necessity of using oxalic acid will depend on the effectiveness of the mechanical methods of removal and the final decommissioning criteria determined for site closure.

DEFENSE WASTE PROCESSING FACILITY

DWPF continues to vitrify radioactive waste at a rate of approximately three-quarters of a canister of glass per day. New methodologies are being evaluated to replace the In-Tank Precipitation (ITP) process for pretreating the salt feed to DWPF.

In February 1998, DOE-SR directed WSRC to suspend startup activities for the In-Tank Precipitation (ITP) facility, pending the completion of an evaluation of potential alternatives for separating cesium from the salt portion of SRS High Level Wastes. The decision to suspend activities was the result of a two-year chemistry testing program which concluded that the present ITP system configuration could not cost effectively meet safety and production requirements. Excessive generation of benzene due to decomposition of the precipitation reagent (sodium tetraphenylborate) was the cause for failure of the process.

A WSRC Systems Engineering (SE) Team was formed in March 1998 to perform an evaluation of alternatives to the ITP process. A three-phased evaluation process was performed. Phase I of the process identified over 120 potential alternate processes. Further evaluations narrowed this list down to 18 alternatives for the investigation phase (Phase II). From these investigations, a short list of four alternatives was forwarded to the final selection phase.

Detailed process flow sheets and life cycle cost estimates were developed to establish discrimination factors for the selection process. The WSRC SE Team completed evaluations in October 1998 and provided a primary and back up alternative to DOE recommending commencement of conceptual design efforts. A DOE-SR Review Team provided oversight of SE Team activities throughout the evaluation process. Three alternatives, direct grout, ion exchange, and small-tank ITP, are being considered.

As a result of the oversight review, DOE-SR concluded there are significant technical and other uncertainties associated with the alternatives included in the final evaluation phase that should be investigated further before a preferred alternative can be selected. The additional research and development activities are needed to ensure the most informed decision is made when selecting the preferred alternative. DOE-SR issued a memorandum to EM-1 on December 16, 1998, requesting concurrence with recommendation to perform additional work to address the identified risks and uncertainties prior to selecting a preferred alternative. The Acting Assistant Secretary agreed with the SR position in January 1999 and approved the path forward. The first step in this process is the preparation of a Supplemental Environmental Impact Statement (EIS) based on the three options. This will result in a Record of Decision in late FY2000.

HANFORD

BNFL, Inc. has been awarded a two-part contract worth approximately $6.9 billion for the immobilization of about 10% of the mass, or 20-25% of the radioactivity in Hanford’s 54 million gallons of waste by 2018. The initial part of the project is a 24-month design phase that will result in private financing closure, regulatory permit applications, readiness to begin construction, final fixed-unit prices for treated waste, and a firm schedule for cleanup to occur. The second part of the contract will provide for the construction of the facilities, followed by treatment and immobilization of the waste contained in the tanks at a fixed-price.

To manage the Tank Waste Remediation System (TWRS), the Department has established the Office of River Protection (ORP). The ORP mission is to store, treat, immobilize, and dispose of the highly radioactive Hanford Site waste in an environmentally sound, safe, and cost-effective manner. The long-term goal is to protect the Columbia River from future tank waste leaks. Some of the project components are described below.

Safety Issue Resolution - A number of waste tank safety concerns were identified in the late 1980's. Restrictions were place on 54 tanks with serious potential for the release of highly radioactive material in the event of uncontrolled increases in temperature or pressure. Without

corrective action, these safety issues pose an unacceptable risk for continued storage and future waste retrieval actions.

Waste Characterization - The waste characterization activity gathers and provides information on the quantity and radiological, chemical, and physical characteristics of the tank waste. This information is used to receive, transfer, store, and evaporate waste; identify and resolve safety issues; and plan for retrieval, treatment, and immobilization of the waste. Information is obtained from process records and through waste sampling and analysis.

Authorization Basis - to protect the workers and the public, waste storage and future retrieval and immobilized waste storage activities conducted in nuclear facilities must be within the controls established in an Authorization Basis. These controls are determined by analyzing normal, abnormal, and potential accident conditions and establishing controls with an adequate margin of safety.

Waste Surveillance - Surveillance activities must be conducted to ensure that the waste is safely stored until it can be retrieved for processing and disposal. These activities include measuring waste liquid level, waste temperature, tank pressure, flammable gas concentration and ventilation air flow, as well as monitoring for tank waste leakage and airborne and surface contamination.

Tank Management - The limited space within the 28 Double-Shell Tanks (DSTs) must be managed to satisfy competing demands for tank storage space and thereby minimize the need for building more DSTs. Plans for using DST space and the potential need for additional tanks are updated annually. Single-Shell Tank (SST) interim stabilization has been underway for several years to transfer pumpable liquid from the SSTs to the DSTs. This reduces the amount of liquid waste available to leak to the ground should a leak develop.

Tank Farm Upgrades - While much of the tank farm instrumentation and equipment is old and obsolete, most of the waste will remain in the tanks for another 20 to 30 years. Projects have been authorized to replace ventilation systems, electrical systems, pipelines, and instrumentation. The upgrades will also support waste retrieval operations during Phases I and II.

Vadose Zone/Groundwater Activities - The tank farms are regulated as hazardous waste management units that must comply with appropriate regulations. The regulations require monitoring of the groundwater for potential impacts to groundwater quality from leaks and spills and, when impacts are identified, characterization of the vadose zone (soils above the groundwater) and groundwater. The Environmental Restoration Program manages the Sitewide Groundwater/Vadose Zone Integration Project, which provides integrated planning, identifies baseline assumptions and data needs, and ensures consistent technical approaches.

Waste Retrieval - Waste will be retrieved from selected DSTs and SSTs during Phase I and pumped to the treatment and immobilization facilities operated by BNFL, Inc. After retrieving the waste from the tanks, a tank closure plan will be prepared.

Waste Processing - Once transferred to BNFL Inc., the tank waste feeds will be treated, resulting in two fractions, High-Level Waste (HLW) and Low Activity Waste (LAW), that are suitable for immobilization. Treatment will consist of removing cesium, strontium, technetium, and transuranics from the LAW using one of a number of processes (e. g., ion exchange and precipitation) and blending the removed radionuclides with the HLW stream. The remaining larger volume of waste, including most of the nonradioactive chemicals in the waste, will make up the LAW stream. Both streams will be immobilized.

Immobilized Waste Storage and Disposal - The vitrified HLW will be stored onsite until federal geologic repository is ready to accept it for disposal. The approximately 600 canisters of vitrified HLW produced during Phase I will be stored in the Canister Storage Building under construction in the 200 East Area at Hanford.

SUMMARY

While 1998 introduced many transitions across the DOE complex, the individual sites continue to make important progress in completing their missions. As vitrification winds down at West Valley, final clean-up issues are coming to the fore. At DWPF, selection of the pre-treatment method will allow vitrification to continue its successful campaign. And privatization of vitrification at Hanford will usher in a new method of doing business for the Department.

The success demonstrated in handling these difficult transitions in 1998 can only foretell even greater success in the future.