PREPARING T PLANT TO STORE K-BASIN SLUDGE

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ABSTRACT

For a number of years, the spent nuclear fuel (SNF) from the N Reactor has been stored underwater in the basins at the 100 K Area complex of the Hanford Site (K Basins). Fluor Hanford is managing a significant effort to remove the fuel from the K Basins and place it in dry storage. Removing accumulated sludges from the basins is also a part of this activity.

Over time, corrosion by-products from degrading fuel rods, storage-rack rust, concrete fragments from pool walls, and environmental particulates have led to the accumulation of sludge on the floors and in the pits of the K Basins. Handling and cleaning the SNF as it is removed from the K Basins will generate additional sludge. Due to the age and condition of the basins, there is a potential for sludge and basin water to leak into the environment. This potential has created the impetus for removing the sludge, in addition to the fuel, from the basins as quickly as possible and placing it in a safe and secure storage configuration pending disposition.

The T Plant will be used to store sludge from the K Basins (Fig. 1.). Therefore, T Plant is being "cleaned up" and modified to accept the sludge. Cleanup consists of removing a large inventory of stored materials from the T Plant's canyon deck and process cells to facilitate the placement and operation of a sludge handling and storage system. The sludge handling and storage system is comprised of several sub-systems and components that are necessary to receive, unload, store, and maintain containers of SNF sludge. A helium purge system and a load cell were developed to support receipt and unloading of sludge containers. Safely storing the sludge containers requires certain measures including secondary containment, storage racks, and leak-detection systems. The systems designed to maintain the containers while in storage include a system to add water to the large containers and a system to provide backup containment in the event that a container should leak. In addition, the existing camera system will be upgraded to provide surveillance capabilities.

INTRODUCTION

This paper will explain the history and status of the modification of the Hanford T Plant facility for storage of K Basin sludge. It will describe briefly the evolution of the T Plant from one of Hanford's original a chemical processing facilities to a waste handling, interim storage, treatment, and repackaging facility. This paper will focus on the preparation of T Plant for

storage of sludges from the Hanford fuel storage basins, an activity critical to reduction of environmental risks and protection of the Columbia River. These activities will also contribute to the preparation of the facility for a future mission as Hanford's remote-handled and oversized waste processing facility.

Fig. 1. T Plant Complex

T PLANT HISTORY

The T Plant chemical processing facility was constructed in 1944 to extract plutonium and uranium from production reactor fuel using the bismuth-phosphate process. The T Plant mission as a fuel-processing facility was discontinued in 1956; in 1957, the facility was converted to a beta-gamma decontamination facility and a support facility for experiments or other operations requiring containment or isolation. Waste handling, interim storage, treatment, and repackaging operations are currently performed at T Plant, and the facility provides flexible work areas to accommodate other activities essential to the Hanford mission (e.g. headspace gas sampling in support of transuranic waste certification).

Facility structures that will play significant roles in storing sludge include the railway tunnel; the 221-T process area known as the "canyon"; at least four process cells within the canyon; the pool cell (cell 2R); and the operating, electrical, and pipe galleries. The sludge-handling project provides for the design or modification of equipment or structures needed to support sludge receipt and interim storage.

K-BASINS' HISTORY

The K-East (KE) Basin, built in the early 1950s, was originally used for the short-term storage of single-pass reactor fuel during production years. It is currently is being used to store canisters of N Reactor spent nuclear fuel (SNF) that was placed in the basin starting in 1975. In 1992, the decision to deactivate the PUREX Plant left approximately 2,100 metric tons of SNF in the K Basins with no means for near-term processing.

The N Reactor fuel in the KE Basin is stored in open-top canisters. Some canisters have closed bottoms and others have screened bottoms. The open canisters release soluble fission products into the basin water and also allow fuel corrosion products to combine with canister rack rust, concrete dust, and environmental particulate matter that settles to the basin bottom as a fine sludge. Sludge depths of more than three feet have been measured in specific areas within the basins (the weasel pit). The potential for basin water and sludge to leak to the environment because of the age and condition of the basins provides the impetus for removing the sludge from the basins as soon as practical.

T PLANT ROLE IN SLUDGE MANAGEMENT

In mid 1999 after the process of storing the sludge in Tank Farms was deemed impractical, a team at the Spent Nuclear Fuel project (SNF) was tasked to develop alternatives for storing sludge. Storage inside of one of the canyon buildings was proposed and another team was commissioned to determine whether or not dry storage in a canyon building was feasible. Indeed, the idea was sound and T Plant was the best option, an option enhanced by the future T Plant mission to process and disposition oversized and remote-handled transuranic and mixed wastes. Storing sludge from the K Basins at the facility where it would likely be prepared for disposal was advantageous. The team then had to decide what it would take to place sludge in T Plant, both physically and in order to meet applicable requirements. The team's first engineering challenge was to publish a design requirements document that listed all of the prerequisites necessary to store the sludge in T Plant. Once produced, this document had to be kept up to date while the scientists and engineers at the K Basins continued interpreting the sludge sample data and providing engineering documents to the team on sludge characteristics. In addition, the sludge needed to be classified to determine regulatory requirements once in storage. A determination was made early in the process that the waste was not Dangerous Waste and was classified as remote-handled transuranic waste (RH-TRU). Due to the presence of polychloride biphenyls (PCBs) in the waste, the sludge carries an additional Toxic Substances Control Act (TSCA) label and inspection and storage requirements were negotiated with the Environmental Protection Agency.

PREPARING T PLANT FOR THE SLUDGE MISSION

The preferred method for storing sludge in T Plant was determined to be in process cells in the canyon. The T Plant team initiated actions to plan the start of clearing deck sections (Fig. 2.) and removing equipment and other items from the eight cells (maximum) needed to store sludge. The T Plant canyon contained significant amounts of stored equipment and materials from earlier process and decontamination missions. A number of large pieces of process equipment (referred

to as towers) were on the deck covering two to three cells. To accommodate the systems for storing the sludge, these towers needed to be disposed in the burial ground. Two of these towers had been conservatively evaluated to contain TRU quantities of fissile material and would require size reduction and packaging for eventual disposal at the Waste Isolation Pilot Plant. In addition, there were over 145 empty containers in the canyon, with 55-gallon steel drums representing the majority of the inventory. Other items stored in the canyon would challenge the T Plant team to develop a disposition path forward.

Fig. 2. T Plant Deck

The T Plant team's goal was to remove the equipment from 13 deck sections and 8 cells and place all of the equipment in final disposal in the Low-Level Burial Grounds. Involving the Waste Services group early in the planning process allowed a cost effective and efficient path for disposing of the equipment and materials in the canyon. Of particular concern were several large "Drag Off Boxes" that had been used to store high- contamination and high-dose equipment over the last 20 years. The team had to develop methods to sort, repackage, and appropriately dispose of the wastes in these boxes. This effort was aided by the installation of new camera systems on the canyon crane and in the canyon. The initial videos, supplemented by digital photography, proved to be an acceptable method to document box inventories and status ongoing actions.

The disposal of the process towers and other large equipment was initiated, using a variety of methods and innovations including a large shearing system, plasma arc torches, painted coatings to contain contamination, special packaging for transportation, and more accurate assay systems to determine TRU content (two towers conservatively managed as TRU waste were determined to actually be low-level waste).

Once the decks had been cleaned off, work began on the cells. A detailed inventory of cells did not exist and the team had to systematically open cells, create video records of the contents, and start a database based on history and most current visual inspection. Discoveries during this cell inventory process led to the formation of a "cell investigation team," which was commissioned to develop the most accurate information on each cell's contents, through review of historical records, plant history and personnel experience. Before each cell was opened, the team convened, discussed inventories, and gave permission to proceed.

T Plant also stored 72 blanket fuel assemblies for the Shippingport reactor under water in racks in cell 2R since 1978. Due to the age of the fuel and the need to possibly use cell 2R to store the more reactive sludge in T Plant, the fuel is being removed (Fig. 3.) The fuel is being loaded in canisters and moved to the Canister Storage Building awaiting shipment to the SNF repository. T Plant has completed 7 of the 18 shipments of fuel and is expected to have all of the fuel moved in late 2003. The approach for storing the more reactive sludge in T Plant is scheduled for completion in mid 2003 with modifications to T Plant starting once the design is approved.

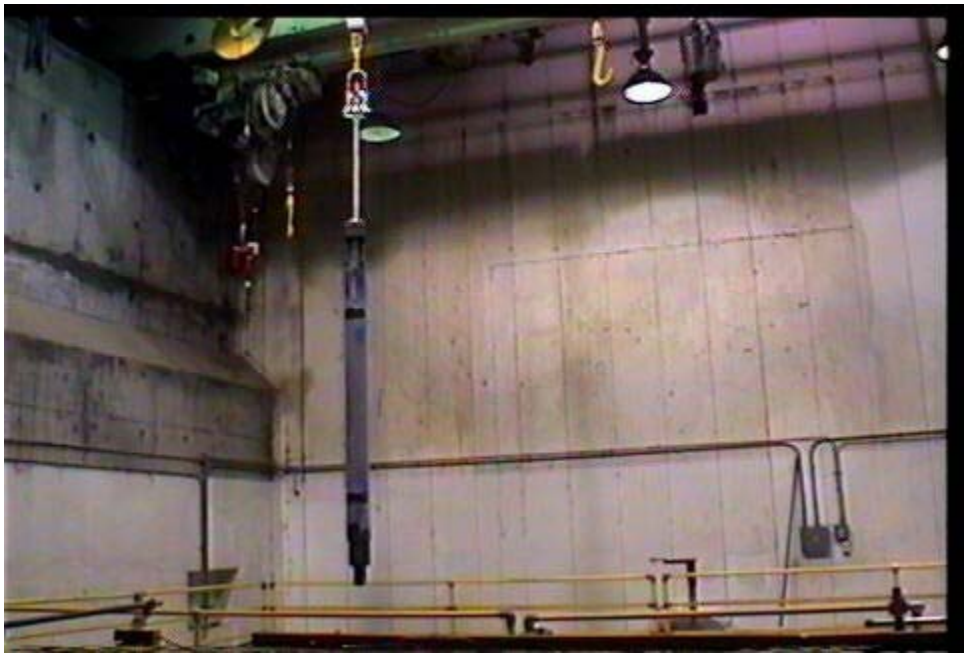

Fig. 3. Fuel Removal at T Plant

SLUDGE STORAGE SYSTEM INSTALLATION

The SNF design team developed and issued the design for dry storing sludge in cells. The design included a leveling base that fit into the cell bottom and was designed to provide a stable base for a containment system to hold six Large Diameter Containers (LDCs) of sludge. One location in each containment basin was reserved for an overpack in the event a container developed a leak in the 30-year designed storage life. Leveling bases and containments fabricated by a local business. The containment system (Fig. 4.) included a sump and leak detector and accommodated a sump pump should a leak occur. Additional ports to plug in high-resolution

video cameras on either side of the sludge cells were installed and will provide an additional inspection method to meet EPA requirements. In addition to the cell upgrades, a system was designed to measure small differences in pressure in the LDCs to determine if hydrogen generation was a problem before moving the LDC. The system was installed to purge the cask and the LDC with helium upon receipt to reduce the hydrogen flammability issues, monitor pressure in the container, and to validate when it was safe to move the LDC out of the cask and into a cell. With the additional source term to be stored in the canyon, the facility also upgraded the ventilation exhaust stack to a NESHAPS Major Stack. This involved installing new constant air monitors and alarms, and verifying that the system operated as stated in the air permit.

Fig. 4. Sludge Storage System in T Plant Cell

CONCLUSIONS

Cleaning out T Plant to store sludge from the K Basins has been a significant undertaking. It has taken three years to clean the canyon: 15 deck sections were cleared; 8 cells were cleaned; 19 large pieces of equipment and 6 PUREX Process Towers were removed; 145 Empty Drums were crushed and removed; 68 Waste Containers filled and removed for a total of 30,646 cubic ft of waste (27,082 cubic ft of low-level waste and 3,564 cubic ft of mixed low-level waste) placed in the low-level burial ground–totaling more than 170 tons of waste. In addition, 28 Shippingport fuel elements have been removed and transferred to dry storage.

Technologies applied included a clamshell for cleaning out cells, a large Labounty shear for size reduction, a drum crusher to reduce waste volumes, and a plasma torch to size reduce. Workers were involved in all facets of this undertaking. The Lead Operator and Health Physics Technician were not only involved early on in the planning, but also in the decisions on how the

team would proceed with each phase. This team concept ensured success as the work progressed and the project moved toward completion.

When the project is complete, four cells in T Plant will contain 24 LDCs, each with a maximum of two cubic meters of sludge. T Plant will perform the annual inspection and weigh containers to determine water loss through evaporation and will add water to the containers as required. Keeping the sludge wet will aid in removing the sludge from the LDCs once a capability to treat the sludge for disposal at WIPP is in place. T Plant, designated as the primary candidate for the Hanford Site Remote Handled TRU Facility, is suited as the storage site for the sludge from the K Basins because of its thick concrete walls, existing infrastructure, and planned modifications to meet the RH-TRU mission.