WASTE HANDLING & PACKAGING PLANT PROJECT DESCRIPTION

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ABSTRACT

The Waste Handling & Packaging Plant (WHPP) is proposed to provide processing, packaging, and certification of transuranic waste to meet the Waste Acceptance Criteria for the Waste Isolation Pilot Plant (WIPP). All waste-handling activities will be remotely operated in shielded cells. A key design feature is the large double-lid transfer system for transferring the solid waste into the process cell. The remote-handled transuranic (RH TRU) waste to be processed as the main mission will require a facility qualified for alpha confinement with shielding for gamma and neutron radiation doses up to 1500 R/h. Processed certified waste will be loaded into inner containers, or liners, and then transferred out of the cell into Type A drums. The drums will be checked for contamination, decontaminated if necessary, and then documented as required. If necessary, the drums will be loaded into the RH TRU canister and remotely welded. The certified packages will be loaded into Type B shipping casks, and shipped to WIPP. RH TRU liquids and sludges stored in the Melton Valley Storage Tanks (MVSTs) at ORNL will be mobilized and pumped by underground pipeline to the WHPP. Solidification will be accomplished utilizing an innovative evaporation-type flowsheet. This will involve a combination of evaporation and melting. The melting will be accomplished using microwave energy.

INTRODUCTION

ORNL currently has in retrievable storage in trenches and a bunker about 300 m^3 of RH TRU solid waste. This material is comprised of waste materials from about 20 years of operation of radiochemical processing and packaging facilities. The RH TRU wastes have been retrievably stored since the early 1970s. The predominant constituents are: sample bottles, wipes and gloves, small tools and equipment, polyethylene bags, equipment racks, and miscellaneous fuel materials. These materials contain TRU concentrations of >100 nCi/g and have a contact dose rate in excess of 200 mrem/h. All of this material will be processed through the WHPP.

PROJECT DESCRIPTION

The WHPP is proposed to be located on a site in the Southwest portion of the ORNL complex as shown in Fig. 1. It will be located about 500 ft. from the MVSTs where the slurry is stored. This site is also close to where the solid waste is currently stored, and near where ORNL plans to construct new waste storage bunkers. The WHPP facility will have about 10,000 ft^2 of hot cell space for processing liquids and solids, for examination and certification, and for packaging and loading shipping casks. The hot cells will have walls three ft. thick to provide shielding for gamma dose rates of up to 1500 R/h. Double-lid transfer devices will be utilized to minimize the spread of contamination in the WHPP during transfer of incoming solid waste into the hot cell for processing, and for transferring out all completed 55-gal drum packages of waste. A cutaway illustration of the WHPP is shown in Fig. 2.

The conceptual flow sheet for processing solids through WHPP is depicted in Fig. 3. A docking cask with the concrete cask or drums, containing waste, will be brought to WHPP and introduced to the waste processing cell through a double-lid transfer device. Once inside the cell, the capability will exist to evaluate the contents of the waste package by either real-time radiography or neutron-assay techniques. Once the cask or drum is opened, the waste will be sorted and processed as required through size reduction, compaction, and fixation (for liquids, corrosives, or particulates). The processed waste will be loaded into a clean drum liner and then into a clean drum. After confirmation of lack of external contamination, the drums will either be loaded into the proposed RH TRU drum shipping cask or loaded into a RH TRU canister and the canister cask for transport to the WIPP.

Initial characterization data for the contents of the MVSTs indicates the supernatant is a highly basic, concentrated sodium nitrate solution that also contains lower concentrations of calcium and magnesium cations, and hydroxide, carbonate, bicarbonate, chloride, phosphate, and sulfate anions. The tanks contain significant quantities of alpha-, beta-, and gamma-emitting radioisotopes. The alpha activity is concentrated in the sludges and is a result of the presence of TRU isotopes. The sludge consists of

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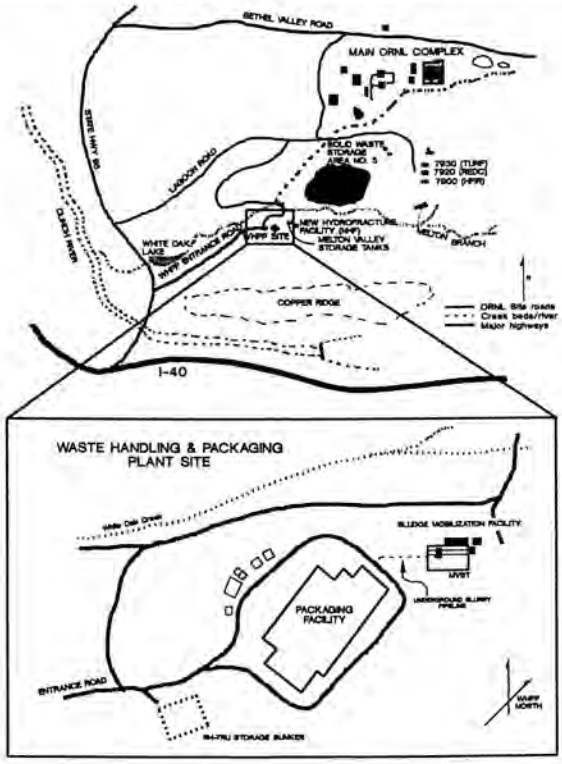


Waste Handling & Packaging Plant–Siting Plan.

Fig. 1. ORNL site map.

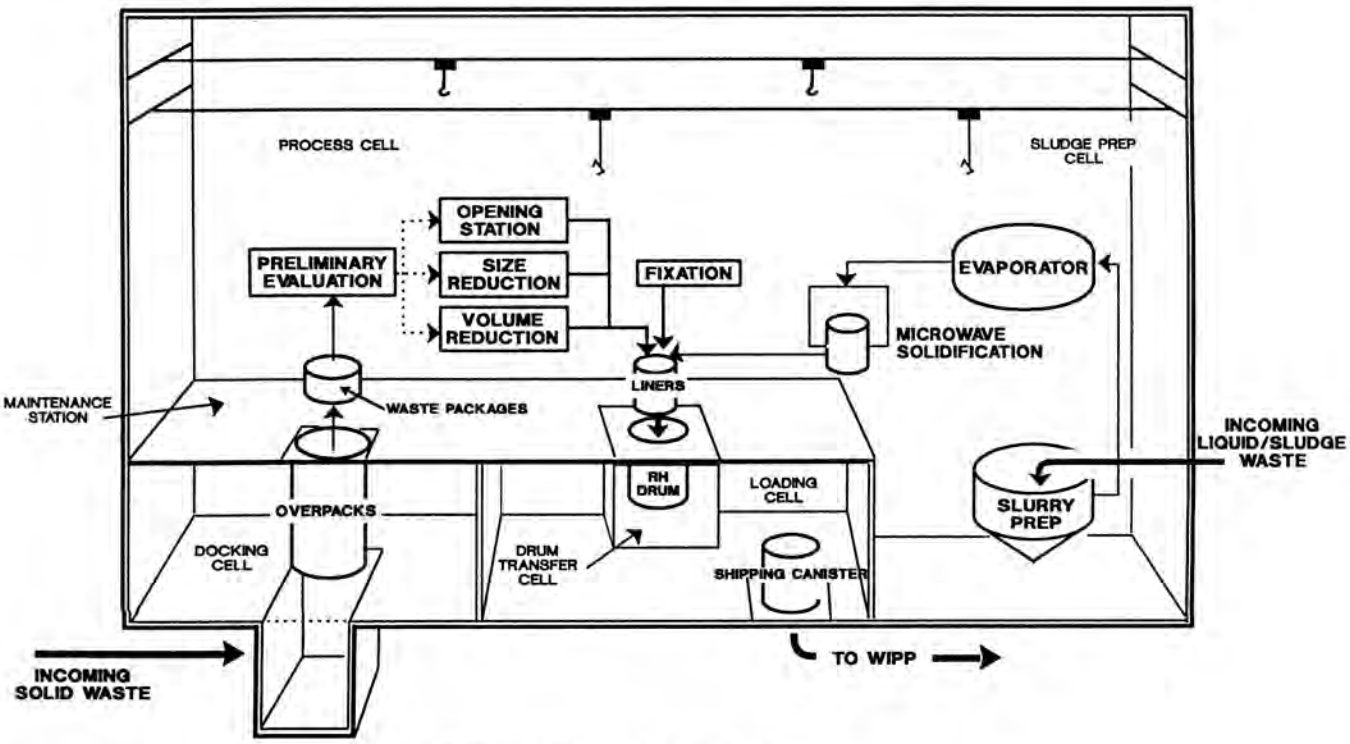
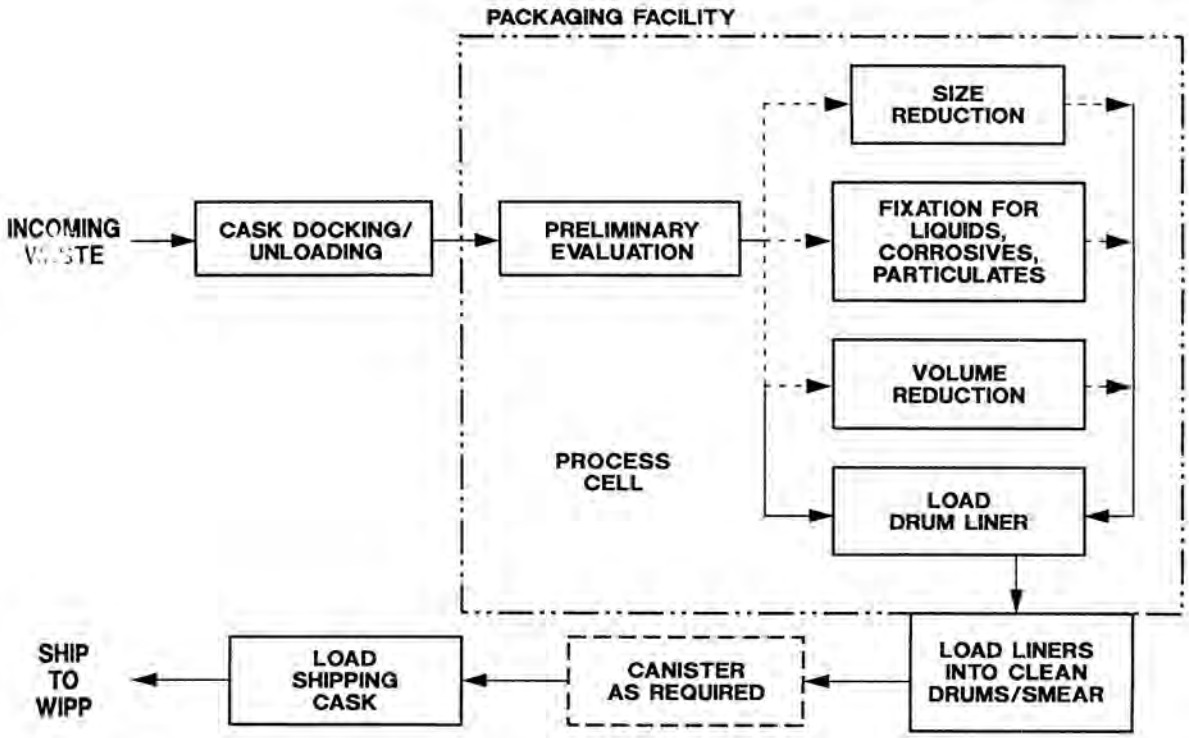


Fig. 2. Conceptual WHPP cutaway.



Waste Handling & Packaging Plant Conceptual Solids Processing Flowsheet.

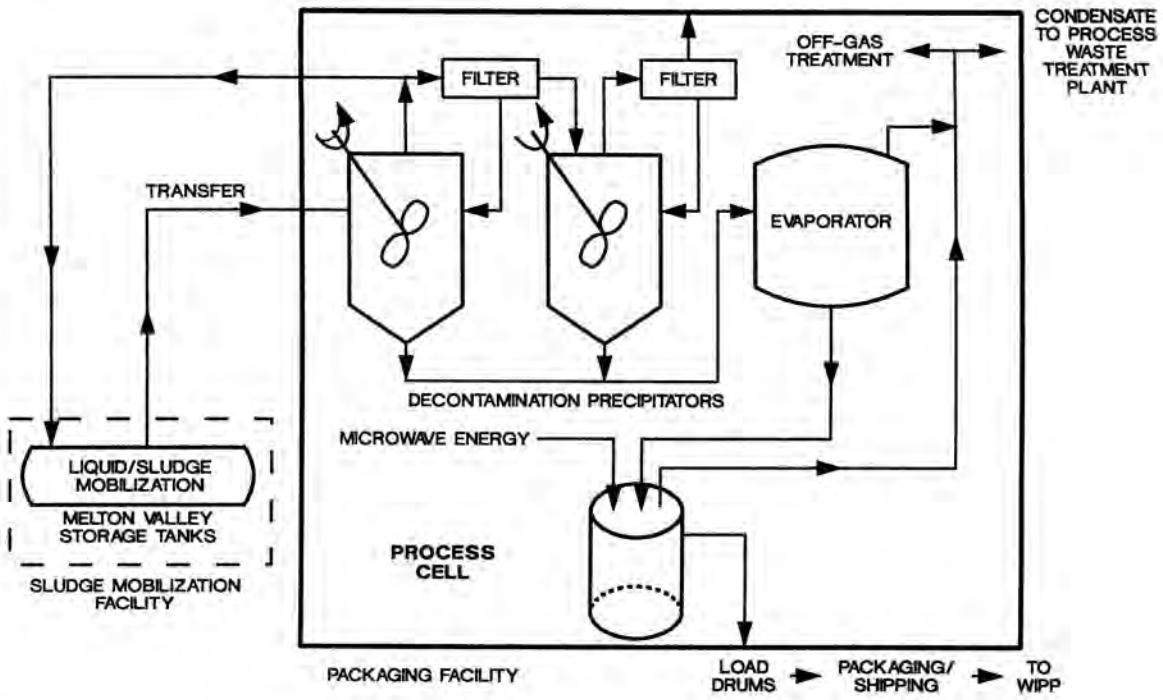
Fig. 3. WHPP conceptual solids processing flow sheet.

hydroxide and carbonate precipitates of the species present in the supernatant. In addition, significant quantities of bentonite clay and sand are present which were introduced during the clean-out of the gunite waste storage tanks. It is expected that more than 500,000 gal of supernatant/sludge mixture (hereafter referred to as slurry) will be processed through the WHPP.

The initial step in processing the currently stored TRU sludge is to form a slurry and remove it from the tanks. This process will be designed so that the sludge will be mobilized from each MVST by using liquid supernatant with minimal addition of water. This task is complicated by the fact that the waste is heterogeneous. Waste characteristics differ for each of the eight tanks and may vary within a given tank. The sludge will be characterized to ensure that it can be removed from the tanks and transported to the WHPP as a slurry without fouling or plugging pipes, pumps, and other equipment. A near full-scale MVST model has been constructed and will be operated to prove the effectiveness of the most promising sludge mobilization techniques. After mobilization, the slurry must be transported to the slurry preparation tank located at the WHPP facility. Accurate sizing of slurry transport hardware is important. Pipe diameter will be selected to be large enough to prevent plugging while being small enough to maintain a linear velocity adequate to keep solids in suspension.

The next step in processing the slurry is to adjust the liquid/sludge ratio to attain the desired solids loading, and $NaNO_3$ concentration. Evaporation equipment will be designed to handle a range of solid concentrations that corresponds to the TRU solids loadings for which the process is qualified to operate. Sodium nitrate is necessary to bind molten solids and salts into a monolith. The slurry preparation step will be used to adjust the liquid/sludge ratio so that the incoming slurry meets the requirements for processing.

The slurry process flow diagram from the WHPP Conceptual Design Report is depicted in Fig. 4. Utilizing supernatant as the motive fluid, sludge will be mobilized from the bottom of one of the MVSTs. The resultant slurry will be transported to a gravity separator where the solids will settle, and the supernatant will return to the sluicing operation. The sluicing process will continue until the required amount of solids are in inventory in the separator tank. When this concentration is reached, the tank will be agitated and the slurry will be transferred to the wiped film evaporator. From the evaporator the slurry will be transferred to a drum liner, where it will be further heated by a microwave melting system. After cooling, the drum liner will be loaded into a clean drum and then handled in a fashion identical to the solid waste drums.



Waste Handling & Packaging Plant Conceptual Slurry Processing Flowsheet.

Fig. 4. WHPP conceptual slurry processing flow sheet.

Several of the systems chosen for the WHPP require development. The cask transfer system is a critical item required to support double-lid unloading of solid waste from the concrete waste storage casks to the process cell without breaching containment or contaminating surfaces of the system presented to the operator (the "clean side"). Linear accelerator (LINAC)-based nondestructive assay (NDA) and nondestructive examination (NDE) equipment will be utilized for the in-process examination and assay of the RH TRU wastes processed through the WHPP.