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For Questions, call Carla Dwight, (208) 533-7651,
FAX (208) 533-7735

CHARACTERIZATION OF MIXED CH-TRU WASTE FOR THE WIPP EXPERIMENTAL TEST PROGRAM CONDUCTED AT ANL-W

By: C.C. Dwight, G.C. McClellan, K.P. Guay (Fuel Cycle Division, Argonne National Laboratory, P.O. Box 2528, Idaho Falls, ID 83403), J.C. Courtney (Louisanna State University, 10326 Hackberry Ct., Baton Rouge, LA 70809), and M.J. Duff (Consolidated Technical Services, Inc., 8992 Grape Cr. Rd., Walkersville, MD 21793)

ABSTRACT

Argonne National Laboratory is participating in the Department of Energy's Waste Isolation Pilot Plant (WIPP) Experimental Test Program by characterizing and repackaging mixed contact-handled transuranic waste. Characterization activities include gas sampling the waste containers, visually examining the waste contents, categorizing the contents according to their gas generation potentials, and weighing the contents. The waste is repackaged from 0.21m^3 (55 gallon) drums into instrumented steel test bins which can hold up to six drum-equivalents in volume. Eventually the loaded test bins will be shipped to WIPP where they will be evaluated during a five-year test program. Three test bins of inorganic solids (primarily glass) were prepared between March and September 1991 and are ready for shipment to WIPP. The characterization activities confirmed process knowledge of the waste and verified the nondestructive examinations; the gas sample analyses showed the target constituents to be within allowable regulatory limits. A new waste characterization chamber is being developed at ANL-W which will improve worker safety, decrease the potential for contamination spread, and increase the waste characterization throughput. The new facility is expected to begin operations by Fall 1992. A comprehensive summary of the project is contained herein.

INTRODUCTION

Argonne National Laboratory (ANL) and EG&G-Idaho, at the Idaho National Engineering Laboratory (INEL), were chosen in 1990 by the U. S. Department of Energy's (DOE) Office of Environmental Restoration and Waste Management to participate in the Waste Isolation Pilot Plant (WIPP) Experimental Test Program (WETP). The WETP activities include characterizing and repackaging mixed Contact-Handled Transuranic (CH-TRU) waste for shipment to WIPP. Once there, the repackaged waste will be studied as part of a

five year test program. This paper describes the program requirements, the Argonne activities and facilities, the associated institutional and documentation issues, and the results from recent characterization efforts.

BACKGROUND

The purpose of the WETP is to provide chemical, physical, and radiochemical data describing the characteristics of the waste. Data generated will be used to: validate previous waste certifications; evaluate the potential for gas generation from corrosion, microbial action, and radiolytic decomposition; document payload compliance for shipping containers; verify process knowledge databases; and show compliance with Environmental Protection Agency (EPA) regulations such as the No-Migration Determination (1) and the Code of Federal Regulations, Title 40 Parts 191, 262, 264, 265, and 268 (2).

Sandia National Laboratories, in conjunction with Westinghouse-Waste Isolation Division and other DOE contractors, has designed multiple tests to evaluate gas generation rates and radionuclide solubility and leachability under simulated repository conditions. The first set of tests are the "Bin-Scale" Tests (3) in which mixed CH-TRU waste will be placed in test bins along with other materials to simulate repository conditions. Test bins are steel boxes measuring 1.22m^2 by 0.91m high instrumented with internal gas-collecting manifolds and various external valves for gas recirculation and collection. Various measurements will be made during the process of loading the waste into the test bins. Then the bins will be emplaced into the WIPP and will be monitored during a five-year test phase to evaluate gas generation rates.

The scope of the other tests, such as the "Alcove" Tests (4) and the solubility and leachate tests (5) are being further evaluated and defined.

In the spring of 1990, the DOE solicited proposals from generators of mixed CH-TRU waste to prepare the test bins. A joint proposal was submitted by EG&G Idaho and ANL. Because of the logistics of EG&G's stored waste and ANL's existing facilities qualified to handle alpha-contaminated materials, the INEL proposal offered the most affordable and feasible option and was selected by the DOE.

Repackaging of the mixed CH-TRU waste from metal 0.21 cubic meter (55 gal.) drums to the test bins requires several characterization activities, as defined in the DOE's Quality Assurance Program Plan (QAPP) (6). These include real-time radiography, fissile assay, container gas sampling and analysis, visual examination, and weighing the contents. These characterization steps provide data for the purpose of

categorizing and quantifying the materials in the mixed CH-TRU waste, such as plastic, glass, metal, and cellulosics that contribute to the gas generating processes of radiolytic, chemical, and microbial decomposition. The characterization steps and the facilities where they are carried out are described in the following section of this paper.

CHARACTERIZATION FACILITIES AND ACTIVITIES

Two facilities at the INEL are involved in the characterization. The Radioactive Waste Management Complex (RWMC) operated by EG&G-Idaho, Inc. stores mixed CH-TRU waste that was shipped from the Rocky Flats Plant in Colorado over the past twenty-one years. These wastes (as well as all of the mixed CH-TRU wastes generated by the DOE defense contractors in the United States) were uniformly categorized in terms of the processes, packaging, and generation location for the purpose of establishing shipping categories compatible with the Transuranic Package Transporter-II (TRUPACT-II). These categories are described in the TRUCON document (7). A facility at the RWMC, the Stored Waste Experimental Pilot Plant (SWEPP), was initially established to examine waste and certify that its contents met the WIPP Waste Acceptance Criteria (WAC) (8) prior to its final shipment to WIPP. The SWEPP has sophisticated nondestructive examination capabilities such as real time X-radiography and neutron and gamma based fissile material assay. Details of these processes are beyond the scope of this paper. The remaining characterization discussions focus on the activities conducted at Argonne facilities in Idaho Falls, designated ANL-West (ANL-W). Drums that are selected to participate in the five-year WIPP test program are removed from the stored inventory at RWMC and transported to ANL-W following radiography and fissile assay examination at the RWMC. Argonne-West is located approximately 32km east of the RWMC. The U. S. Ecology B-2 cask was used for the initial shipments. Argonne-West is developing handling capability for the TRUPACT-II cask which is anticipated for future shipments between the RWMC and ANL-W. The TRUPACT-II cask will also be used for shipment of the prepared test bins to the WIPP.

Characterization activities at ANL-W are conducted in the Hot Fuel Examination Facility (HFEF). The HFEF is an alpha-gamma hot cell complex (9,10) consisting of a large (approximately 21m by 9m by 8m high) argon-atmosphere main cell, a smaller (approximately 9m by 6m by 8m high) air-atmosphere decontamination cell, and several support areas such as the truck lock, hot repair area (HRA), and high bay area. Both cells are heavily shielded by thick (1.22m) high-density concrete walls, with cell viewing provided by leaded glass windows. In-cell handling is done by master slave manipulators and overhead cranes. The HFEF is used primarily for nondestructive and destructive examination of new and irradiated fuel for the

Experimental Breeder Reactor-II at ANL-W and other reactor program experiments throughout the world. To accommodate the WIPP program, a portion of the facility is used to prepare the test bins. Another portion of the facility is currently being modified to enhance the WIPP test bin preparation capabilities at ANL-W. The modifications are discussed in a later section of this paper titled, Waste Characterization Chamber.

Hot Repair Area and Spray Chamber

The two areas within the HFEF currently involved in the WIPP bin preparation activities are the HRA and the spray chamber, a 2.44m by 2.13m by 3.35m high confinement within the decontamination cell. These are shown in Fig. 1. In routine HFEF operations, the spray chamber is used for washing equipment with a high-pressure water spray prior to transferring the equipment to the HRA. For the WIPP activities, the water spray is disconnected and not used. The spray chamber can be viewed through a window and accessed by a pair of master slave manipulators. The roof and back of the spray chamber open to allow the transfer of items from the decon cell. The thick shielding walls of the decontamination cell are not required to shield against the modest amount of radionuclides in WIPP waste. The spray chamber and HRA are only being used as an interim characterization facility until the waste characterization chamber becomes operational.

-(INSERT FIG. 1 HERE)-

Following the flow paths illustrated in Fig. 1, casks sent from the RWMC are received in the HFEF truck lock. They are unloaded and lifted to the high bay using the high bay crane. Then the drums are wrapped in protective plastic sheets to keep them from becoming contaminated in the HRA. The HRA is a potentially-contaminated area as maintenance and repair operations are conducted there on equipment brought up from the cells below. The wrapped drums are transferred through the roof hatch in the HRA to the transfer cart room.

Within the HRA, gas samples are taken from the polyethylene drum liner bags. The gas sampling system consists of a vacuum pump, tubing, multiple sampling and gas standard ports, and pressure and flow sensors exterior to the HRA, and a sample line and needle assembly within the HRA. Operators wearing air-supplied suits enter the HRA, remove the drum lids by unbolting the clamping ring, cut off the rigid polyethylene liner lid using a hydraulic-driven device, and collect a gas sample from the polyethylene drum liner bag by inserting the gas sampling needle and opening a valve. The gas sampling system is controlled by operators in a room exterior to the HRA; visual and voice contact is maintained between the operators inside and outside the HRA. The operation is also videorecorded. The gas samples, collected

in 100ml or 250ml canisters, are sent to the analytical laboratories (discussed later) for analysis.

After the gas sample is taken, the drums are remotely transferred through a hatch in the HRA floor to the decontamination cell below using the HRA crane. Then they are remotely transferred into the spray chamber where visual examination and weighing the drum contents occurs. These operations are conducted on one drum at a time. Between four and six drums fit into a test bin depending on the waste packaging configuration. The visual examination and weighing process entails removing the contents from the drum onto a work table in the spray chamber. The drum is tilted until the master slave manipulators can drag the contents onto the table. Empty drums are transferred back up to the HRA.

The characterization activities within the spray chamber are also videorecorded. Individual bags, packages, or contents of a bag within a drum are weighted, and their weights recorded. The weights of the waste items in each waste category are obtained by actual measurement, measurement of like items, or estimation. Weights of materials in each test bin are used as input for estimates of gas generation. An important step in the waste characterization process is the classification of waste into various categories. The categories are based on gas generation potential as defined by the QAPP. They include: cellulosics, (such as paper, cloth, or wood), plastics, rubber, corroding metals (such as steel or aluminum), noncorroding metals (such as lead, tantalum, or copper), solid inorganics (such as glasses or ceramics), cements, inorganic sludges, and other organics (such as resins or organic sludges).

If the bags or packages within a drum contain sufficient headspace (as defined by the QAPP), then a gas sample is collected from the bag or package while it is in the spray chamber. This is done remotely by opening a valve on an evacuated canister connected to a needle assembly.

Typical alpha contamination levels within the spray chamber are relatively low (< 6000 dpm/100 cm^2) compared to the source term in the WIPP CH-TRU drums. In order to keep the alpha contamination levels as low as possible in the spray chamber, operations proceed cautiously by taking smear samples between each operation and having them analyzed prior to proceeding with the next step. A special tool was developed to aid the visual examination for one of the waste forms, glass labware packed in plastic jars (two to four liters in size). A boroscope (a probe device with a small camera mounted on the end) was developed to visually examine and measure contamination levels of the jar contents without dumping them onto the worktable and potentially spreading contamination.

After each waste item is visually examined and weighed, it is placed into the test bin that is located adjacent to the work table in the spray chamber. The test bin is also wrapped in plastic to protect it from the routine (mostly beta and gamma) contamination in the spray chamber.

After the test bin is full (no partial drums are loaded into the test bin), it is transferred from the spray chamber to the HRA through the hatch in the HRA floor. The test bin lid is installed in the HRA, and then it is transferred to the high bay where it is stored until it is ready to be shipped back to the RWMC. As test bins and empty drums are transferred from the spray chamber, the layers of plastic are removed succeedingly at each different contamination zone. Ultimately, they leave the HRA cart transfer room contamination-free. The plastic layers that are removed and any other discarded materials used in the characterization process, are placed in the empty drums which are handled as low-level waste.

After the loaded test bins are shipped back to the RWMC, a bin headspace sample is collected and analyzed as required by the EPA's No Migration Determination. Eventually the test bins will be shipped to the WIPP where they will be monitored during the five-year test program discussed previously.

Analytical Laboratory

The gaseous constituents of interest in the WIPP test program include twenty-nine volatile organic compounds (VOCs) and ten "inorganic" gases as defined by the QAPP. After a gas sample is collected at HFEF (or at RWMC for bin headspace samples) the sample is taken to the analytical laboratory for analysis. Argonne-West performs the analysis for inorganic gases using gas chromatography. These include argon, methane, hydrogen, ethane, propane, oxygen, nitrogen, carbon monoxide, carbon dioxide, and nitrogen oxides. The samples are analyzed at EG&G's Environmental Chemistry Unit for VOCs using mass spectrometry methods. The quality control requirements for performing the gas sample analyses are extremely tight. Each laboratory must be qualified biannually through an EPA-based performance demonstration program (11) in order to perform the analyses. Argonne-West has passed both of the qualification rounds since the project began.

Waste Characterization Chamber

A new facility, the Waste Characterization Chamber (WCC), is being installed in the HFEF to replace the operations currently conducted in the HRA and the spray chamber. It will be located in the high bay of the HFEF next to the HRA. The WCC is a steel sheet metal box measuring approximately 4.9m by 2.4m by 2.4m high with laminated Lexan (12) viewing windows. The chamber features

two Schilling robotic arms (13) and four glove access ports that will increase the materials handling efficiency. Figure 2 is a sketch of the WCC . This facility will reduce the potential for spreading radioactive contamination and will free the HRA and spray chamber for other operations. Also, the potential for radiation exposure during drum opening and gas sampling will be reduced. Operations in the WCC are scheduled to begin by Fall 1992.

-(INSERT FIG. 2 HERE)-

INSTITUTIONAL AND DOCUMENTATION ASPECTS

In order to conduct the WETP activities at ANL-W, a number of institutional and documentation requirements were first satisfied. In summary these included: obtaining a storage permit per the Resource Conservation and Recovery Act (Code of Federal Regulations (CFR), Title 40, Part 270); negotiating with the State of Idaho regarding an air permit; upgrading the HFEF stack monitor and quality assurance program in accordance with the National Emission Standards for Hazardous Air Pollutants (CFR Title 40, Part 61); performing an analysis per the National Environmental Policy Act (14); writing a Quality Assurance Project Plan as required by the QAPP and getting it approved by the WIPP Waste Acceptance Criteria Certification Committee; passing the EPA-based Performance Demonstration Program biannually; and writing auditable procedures for all characterization and waste handling activities. These activities were actually more time-consuming than the characterization operations.

INITIAL RESULTS

Bin preparation activities began at ANL-W in March 1991. Three test bins were loaded through September 1991. Table 1 summarizes the pertinent physical characteristics of these bins, including some statistics on the characterization activities. Table 2 summarizes the drum gas sample analysis results of the first three bins for the EPA No Migration Determination target analytes.

-(INSERT TABLE I HERE)-

-(INSERT TABLE II HERE)-

CONCLUSIONS

Three test bins were successfully prepared between March and September 1991 and are ready to be shipped to the WIPP upon its initiation of the test program. The characterization activities conducted at ANL-W confirmed process knowledge from the waste generator and verified the nondestructive examinations conducted

at EG&G Idaho's SWEPP facility. The institutional activities required to support the ANL-W project, such as permitting and documentation, were actually more time-consuming than the characterization operations. Lessons learned from the initial characterization activities are being factored into the design and procedures for the waste characterization chamber which is expected to be operational by Fall 1992.

ACKNOWLEDGEMENTS

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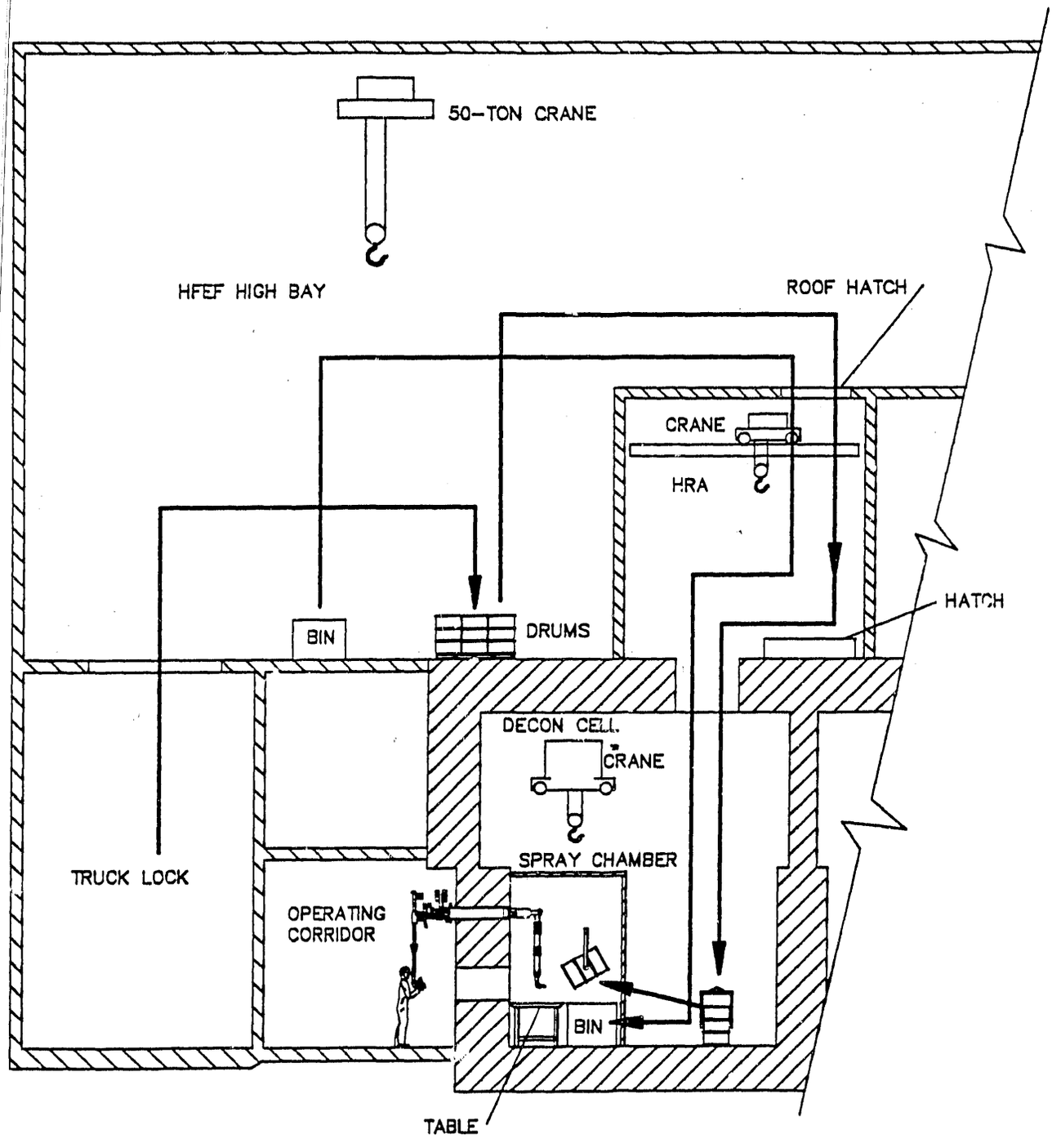

FIGURE 1
WIPP PROJECT WASTE FLOWPATHS
THROUGH HFEF

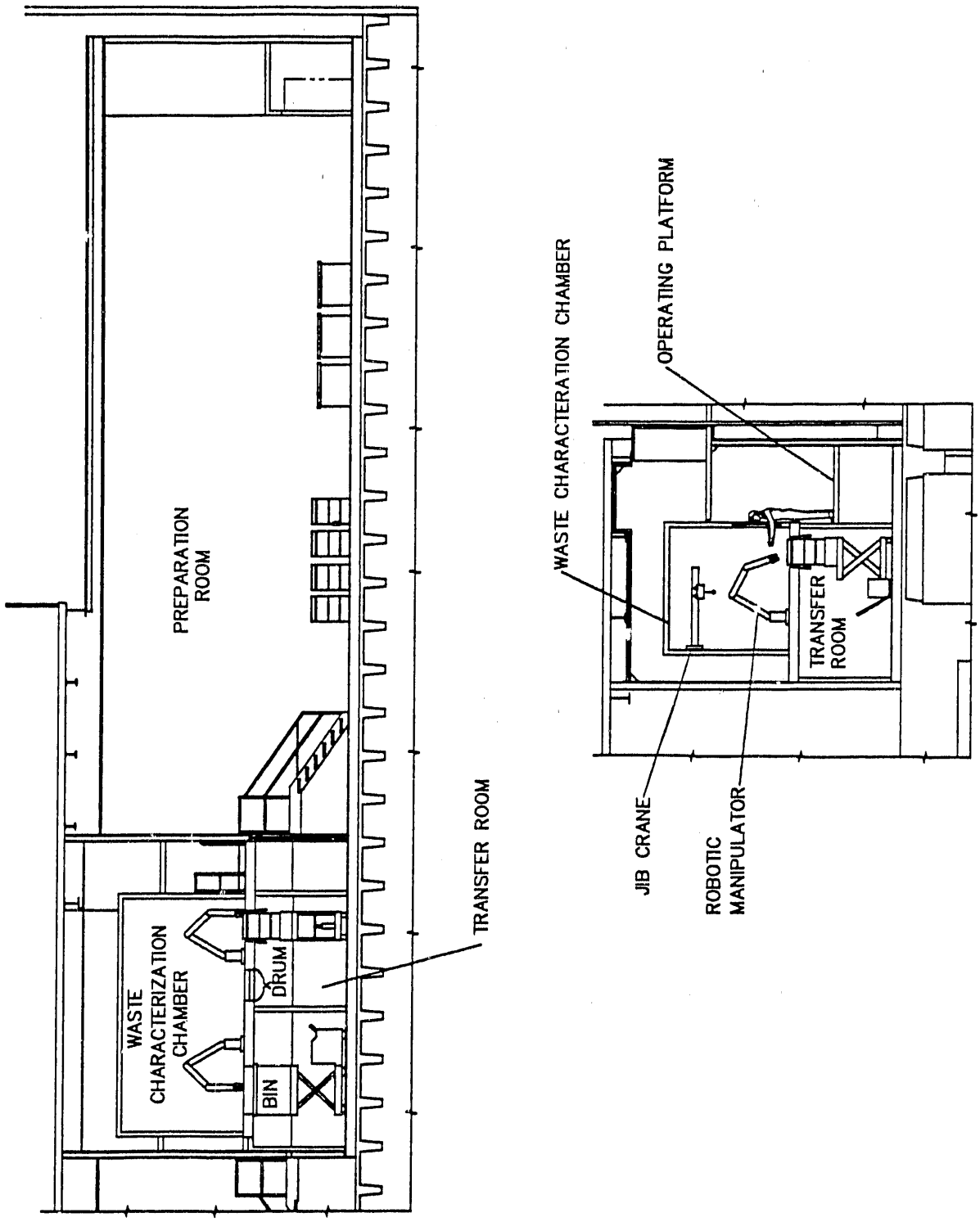

FIGURE 2.
WIPP PROJECT WCC FACILITY IN HFEF

Table I - Physical Characteristics Summary For First Three Bins

CHARACTERISTIC	1	2	3
TRUCON Code	218	218	218
Waste Description	Raschig Rings	Glass Labware in Jars	Raschig Rings; Glass Labware in Jars
Fissile Loading (g)	10.6	73.5	10.0
Highest Drum Surface Dose Rate (Gy/hr)	7.0E-06	1.2E-04	5.0E-06
No. of Drums Loaded in Bin	5	4	4
Approximate Waste Weight (kg)			
Plastics	10	31	18
Inorganic Solids	250	220	132
Cellulosics	7	3	6
Corroding Metals	14	5	11
Totals	281	259	167
Characterization Time (days)	16	43	15
No. of Gas Samples Taken*	47	34	46

*Excludes Bin Headspace at RWMC