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WIPP Conceptual Design Report

Addendum H: Special Equipment Development Program for Waste Isolation Pilot Plant (WIPP) Conceptual Design Report, Prepared by Robert Stinebaugh, Nuclear Waste Engineering Division, Sandia Laboratories, Albuquerque, New Mexico

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ADDENDUM H

SPECIAL EQUIPMENT DEVELOPMENT PROGRAM FOR
WASTE ISOLATION PILOT PLANT (WIPP) CONCEPTUAL DESIGN REPORT

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SPECIAL EQUIPMENT DEVELOPMENT PROGRAM

Introduction

This addendum outlines the planned development program for equipment, identified and conceptually shown in the Waste Isolation Pilot Plant (WIPP) Conceptual Design Report (CDR), that is required for storage emplacement and retrieval of all wastes accepted at the WIPP.

For each item of equipment, the development program consists of four phases:

• Pre-design Phase. Accomplished prior to the start of equipment design.

This phase consists of establishing criteria, identifying items that require development, identifying items that can be adapted from off-the-shelf technology, assessing operational environments, calculations, literature searches, subsystems testing, material selection, etc. Specific pre-design tasks for each item of equipment are identified in the equipment sections.

• Design Phase. This phase integrates the information developed in the pre-design phase into detailed design drawings.

• Fabrication Phase. This phase is concerned with placing contracts, monitoring fabrication progress, and acceptance testing.

• Testing Phase. This phase covers proof testing equipment to assure compliance with criteria. The time allotted for this phase allows design modification and the development of operational techniques and procedures.

The schedule for WIPP special equipment development is pegged to two significant dates:

August 1, 1981. By this time, the TRU-RH ventilation shaft, the construction ventilation shaft, and the man/material shaft will be completed. These completed shafts will allow access for conducting equipment tests on both the transuranic (TRU) and remote-handling (RH) levels.

May 1, 1983. Scheduled date for first waste receipt at the WIPP.

Salt-Drilling Equipment

Drill

Purpose of the Machine -- To drill holes in bedded salt in mine drifts at the RH level of the WIPP for containment of canisters of high-level waste. To drill, ream, overream, and counter-bore the holes for uncanistered waste experiments. To remove the salt grout at the beginning of the retrieval operations of uncanistered waste.

Design Criteria --

Hole diameters	6 to 30 in.
Hole depths	40 ft
Material removal rate	44 ft ³ /hr
Usable life	5 yr
Operators	2
Level adjustments	10 ft of ARC
Maximum height	20 ft
Maximum width	8 ft
Drilled hole axis deviation	1 in. dia in 20 ft

Predesign Tasks -- Design a drill test platform and drive system for drilling in salt blocks to collect the following data and design information:

- Cutter configurations
- Cutter materials
- Cutting removal
- Drill stem design
- Drill stem clamp
- Drill stem drive
- Manifold configurations
- Cutting torque
- Cutting pressure
- Cutter feeds
- Cutter speeds
- Hole accuracy
- Drill stem follow bearing
- Swivel connector; air down drill stem
- Chip separation in collector
- Overreaming
- Reaming
- Counterboring
- Drill stem sectioning
- Heat dissipation

Information and experience gained from these tests will be incorporated into the design of the prototype drill.

Drill Cutting Collector

Purpose of the Machine: To separate salt chips from the airstream using a centrifugal separator.

Design Criteria -- Separate and collect $\sim 44 \text{ ft}^3$ of salt per hour from the drilling airstream.

Predesign Tasks -- Acquire data and information needed for the design of the collector by using the drill test platform and drill system. Determine the correct combination of salt particle size, air volume, air pressure, and particle separator for a successful chip collection system. Use the air compressor mounted on the drill platform for input air. Use the centrifugal separator to enhance airflow and remove salt chips. Assure minimum salt dust induction into drift ventilation system by filter design-and-use tests.

Contaminated Drill Cutting Collector

Purpose of the Machine -- To remove and collect contaminated salt chips formed during waste retrieval operations from the drilling airstream.

Predesign Tasks -- Acquire necessary data and design information by using the drill test system. Tests to gain the required design data and information will include

- Prefilter selection tests
- HEPA particulate loading vs pressure drop
- Flow vs head test on centrifugal separator
- Particulate removal efficiency tests on centrifugal separator

High-Level Waste (HLW) Canister Retrieval Drill System

Purpose of the Machine -- A mechanism to retrieve HLW canisters that are buried in the WIPP experimental drift floors. In the final assembly, the drill system will become an integral part of the retrieval cask; however, during predesign and initial testing, the drill system will be separate.

Predesign Tasks -- Safe retrieval of canisters that are buried in bedded salt presents some formidable mechanical and procedural problems that will require extensive research and testing to solve. A few of these problems are listed below.

- Precise location of the buried canister
- Canister axis orientation
- Salt contamination around the canister
- Drift heat dispersion
- Reliable overreaming regardless of canister condition
- Canister lifting mechanism
- Overcore diameter limited by retrieval cask diameter
- Difficult simulation conditions

Initial development will begin, using the drill platform and drive mechanisms described earlier. In addition, scale models will be constructed and tested using salt blocks to simulate some of the conditions found in the WIPP. The Conceptual Design Report illustrates the equipment envisioned as the first attempt at solving this problem.

Uncanistered HLW Retrieval Drill System

Purpose of the Machine -- To retrieve radioactive loose waste buried in the WIPP experimental area. Very limited information is available about the details of the experiments using uncanistered waste.

Predesign Tasks -- The same development techniques as those used for canister retrieval will be applied to this problem. The Conceptual Design Report depicts the type of equipment to be used for this operation.

Waste, Transport and Handling Equipment

Remote-Handling (RH) Waste Transporter

This item is the vehicle that transports the shielded cask required for canistered waste emplacement and the casks used for canistered and uncanistered waste retrieval. The predesign tasks for the RH waste transporter will include:

- a. Establishing functional criteria; i. e., tractive effort, maximum speed, maneuverability and positioning requirements
- b. Defining structural criteria based on normal operations and accident conditions
- c. Categorizing the operating environment
- d. Selecting safety features
- e. Developing reliability requirements
- f. Performing shielding calculations
- g. Conducting tests on automatic control and guidance system to assure that positioning requirements can be achieved
- h. Sizing and selecting motor generator set to provide power for drive motors
- i. Determining modifications required to motor generator set to comply with mine codes
- j. Establishing need for cask cooling and (if required) selecting the type of cooling

- k. Identifying instrumentation needs for functional monitoring and safety
- l. Conducting basic tests on pneumatic transfer of crushed salt for proposed hole backfill method
- m. Sizing auxiliary hydraulic power unit

Uncanistered HLW Emplacement Cask Trailer

This trailer is used to carry the uncanistered waste emplacement cask from the underground transfer cell to the experimental waste storage area. Additionally, it lowers the cask for mating with the emplacement hole collar. This item is not complex; little difficulty is anticipated in its design.

Transuranic (TRU) Waste Pallet Trailer

This trailer will be used to move palletized TRU waste from the TRU underground receiving station to the storage sites. As currently envisioned, it will be a modified, commercially available item. Predesign tasks to be done before procurement are

- a. Establishing functional and structural criteria
- b. Defining interfaces between the trailer and the prime mover
- c. Identifying safety features

TRU Forklift Barrel-Handling Device

This item is a commercially available barrel-handling adapter that can be installed on standard forklifts. At the WIPP, these adapters will be used individually and in multiples to allow simultaneous handling of several barrels of TRU waste. This item will have to be certified for use at the WIPP by an extensive program of tests to prove its reliability and establishing its service life.

TRU Waste-Handling Forklift

A standard diesel-powered forklift that will be modified for underground handling of TRU waste. Predesign or preprocurement tasks for this item will include

- a. Determining the load capacity requirement
- b. Determining lift height and reach requirements
- c. Establishing shielding material type and thickness for operator's cab
- d. Selecting an exhaust gas treatment system that must be installed to comply with codes for underground diesel equipment
- e. Defining the safety feature package to be added

General-Purpose Tug

This is a multipurpose towing vehicle used to tow the TRU waste pallet trailer and to move other support equipment such as drills and salt-cutting collectors. This tug can also tow a disabled RH waste transporter. Its basic running gear will be adapted from that of commercially available towing vehicles. Before the design of this item can begin, the following tasks must be completed:

- a. Determine load capacity, tractive effort, maximum speed, and maneuverability requirements
- b. Select tow-bar adapters
- c. Select exhaust gas treatment system
- d. Define required safety features
- e. Establish operator cab shielding requirements

TRU Waste Pallet

A reusable pallet for TRU waste handling from the inspection area of the TRU surface facility to the underground storage location. Predesign effort for this item should include

- a. Establishing design loads and design safety factors
- b. Defining features necessary for compatibility with mine shaft cage and the proposed handling equipment

Shielded Waste-Transporter Casks

Five different shielded casks will be required to emplace and retrieve the various categories of remotely handled waste that the WIPP is designed to accommodate. These casks are identified and described as follows:

- HLW Canister Emplacement Cask. Used to emplace canistered commercial high-level waste experiments
- HLW Canister Retrieval Cask. Essentially the same as the HLW canister emplacement cask, except that this cask includes provisions for installing the canister retrieval drill system.
- HLW Uncanistered Emplacement Cask. Used to emplace the uncanistered granulated high-level waste used for experimentation. The cask includes all features necessary for this task. This cask will probably also be used for shipment of this waste.

HLW Uncanistered Retrieval Cask. This cask is the same as the HLW canister retrieval cask.

Intermediate-Level Waste (ILW) Post-WIPP Waste Canister Cask. As indicated in the Conceptual Design Report (CDR), the post-WIPP ILW storage system will not be designed until experimentation has progressed to the point where retrieval requirement can be eliminated. Although post-WIPP storage equipment is not part of the WIPP equipment development program, this cask is conceptually shown in the CDR. It will be similar to the other casks described except that it will contain the additional systems required for horizontal canister unloading.

Before designing these casks, we must complete the following tasks:

- a. Establish package sizes
- b. Define radiation and thermal outputs of waste
- c. Select and size shielding material based on outer cask surface dose-rate requirements
- d. Select the canister hoist system
- e. Establish cask closure geometry
- f. Select construction materials based on environment and ease of decontamination
- g. Set the interfaces between the casks, the transporter, and emplacement/retrieval systems

Development Program Schedule

The schedule for the development of the special equipment required to support the WIPP is attached as Figure 1.

WIPP SPECIAL EQUIPMENT DEVELOPMENT PROGRAM SCHEDULE

Figure 1.