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WIPP Conceptual Design Report

Waste Isolation Pilot Plant (WIPP) Conceptual Design Report
Part I: Executive Summary
Part II: Facilities and System
Edited By Nuclear Waste Engineering Division 1142

MASTER

Prepared by Sandia Laboratories, Albuquerque, New Mexico 87115
and Livermore, California 94550 for the United States Energy Research
and Development Administration under Contract AT (29-1) 789

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WASTE ISOLATION PILOT PLANT (WIPP) CONCEPTUAL DESIGN REPORT

Nuclear Waste Engineering Division 1142
Sandia Laboratories
Albuquerque, New Mexico 87115

FOREWORD

This conceptual design, prepared by Sandia Laboratories for the Energy Research and Development Administration, contains Parts I and II. A separate bound report (Part III) contains the conceptual design drawings.

A list of addenda appears in Part II, Section 5 of this report. Backup data for conclusions reached were obtained from these addenda, which were not incorporated as an integral part of the report because of their bulk. Interested readers may request copies of addenda from the Technical Library, Sandia Laboratories, Albuquerque, NM 87115, by specifying SAND77-0274, addendum letter and title (e.g., SAND77-0274, WIPP Conceptual Design Report, Addendum I, "Soils and Foundation Investigation for Proposed Waste Isolation Pilot Plant, Eddy County, New Mexico, by Richard A. Pettigrew and Associates, Consulting Engineers").

ACKNOWLEDGMENTS

This report required the cooperation of many organizations both outside and within Sandia Laboratories. Acknowledgment of all who participated is not possible, but there are some whose special efforts were fundamental to the success of the conceptual design.

Jim Ash and his staff from Fenix and Scisson, Inc., provided the conceptual design for all the underground development and acted as the prime engineering consultant. Holmes and Narver, Inc., directed by Kent Brown and his staff, acted as consultants to Sandia through Fenix and Scisson, for the surface facility design. The contributions of these two groups provide the foundation for the entire report.

Special acknowledgment goes to the many cooperative and understanding individuals at Sandia without whose input the design could not have been completed. Some who deserve special mention are Mike DeWitte, Earl Gruer, and Mike Nielsen, Plant Engineering; all the personnel from Les Hill's Nuclear Waste Technology Division; Jim Metcalf, Health Physics; Rich Young, Computer Consultant; John Moyer, Safeguards and Security; Jack Armbrust, Safety; Dave Gartling, Thermal Analysis; Wolfgang Wawersik, Rock Mechanics; Bobbi Voelker, Technical Writer; and Al Faychak, John Stott and James Aragon, Drafting.

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*The figures are numbered according to whether they fall in Part I or Part II, then the section number, then the paragraph number, then a subsection number if necessary.

Drawings: The 5- or 7-digit numbers, such as 94534 or 94534-A1, are found in Part III, Drawings.

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ILLUSTRATIONS
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TABLES

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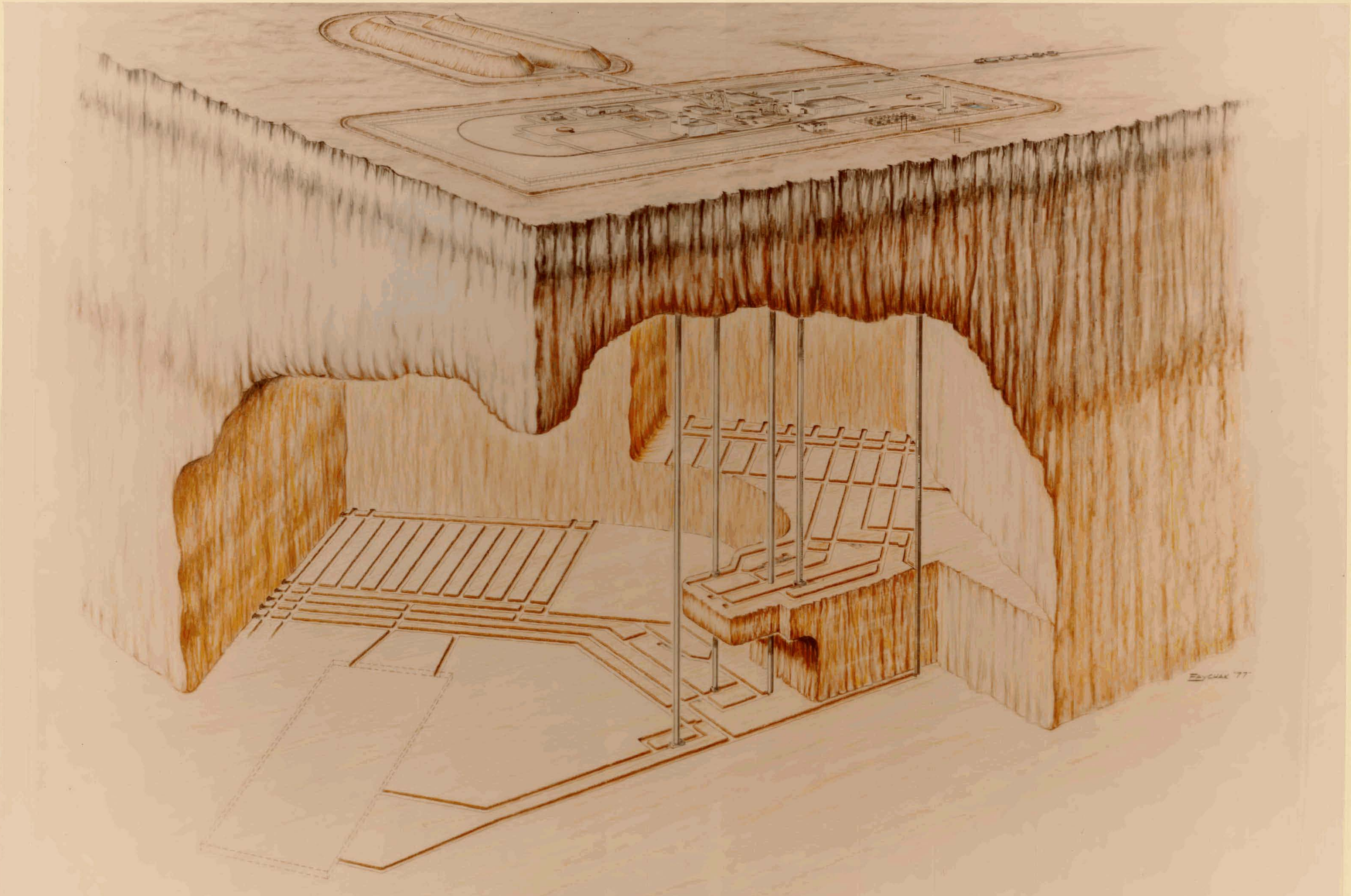

WASTE ISOLATION PILOT PLANT

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INTRODUCTION

The Waste Isolation Pilot Plant (WIPP) will be the first facility designed and constructed to gather data and demonstrate on a large scale the feasibility of disposal of radioactive waste in bedded salt. These wastes were generated by the Atomic Energy Commission (AEC), renamed the Energy Research and Development Administration (ERDA), as a byproduct of developing nuclear weapons. Large quantities of waste now exist, and their generation is expected to continue.

The WIPP is not a pilot plant in the usual meaning of limited, small-scale use at first and then construction of a main plant, but is itself full-scale. Enough laboratory investigations have been conducted to ascertain that the success of the facility is highly probable. The full design capability will not be utilized, however, until sufficient operating and scientific data have been accumulated to assure the safety of both short-term operations and long-term geologic disposal of radioactive wastes. Then the capability of the facility can be expanded to full repository operations with few modifications, mainly more operating personnel and handling equipment. While there is currently no legal requirement to obtain an NRC license for WIPP, nor are there now any NRC licensing regulations, considerable thought has been given to each facility and system to assure that as stringent a design has been produced as though an NRC license were indeed required.

To make the WIPP operational, ~283, 000 ft^2 of floor space in the waste-handling buildings and support facilities must be constructed, along with 1, 500, 000 tons of mining to construct the initial storage space of ~1, 000, 000 ft^3 for the early shipments of contact- and remote-handled waste. When the facility becomes a prototype repository, the current design will allow handling of 1, 200, 000 ft^3 of contact-handled TRU waste and 250, 000 ft^3 of remote-handled waste per year on a three-shift-per-day basis. At this rate, the backlog of contact-handled waste could be reduced about 1, 000, 000 ft^3/year. The facility is designed for an operating life of about 25 years.

1. PROJECT OBJECTIVES

The primary objective of the Waste Isolation Pilot Plant (WIPP) is to demonstrate the adequacy of bedded-salt formations for isolating those contact- and remote-handled radioactive wastes generated by ERDA in support of national defense programs.

A secondary objective is to provide a facility in which experiments can be conducted to extend the understanding of the behavior of other waste types in this geologic medium. To accomplish this secondary objective, experimental quantities of high-level waste are used at the WIPP.

2. PROJECT GUIDELINES

2.1 WASTE TYPE

The pilot plant is developed for ERDA low-level, contact-handled, transuranic waste, ERDA intermediate-level transuranic waste (ILW), and for high-level waste (HLW) experiments. Hereafter, ERDA low-level transuranic waste is referred to as TRU waste, and the other two waste forms are referred to as RH waste. Any subsequent references to ERDA intermediate-level waste (ILW) imply ERDA intermediate-level transuranic waste (ILW).

2.2 WASTE PROCESSING

All wastes placed in the WIPP arrive at the site processed and packaged in final form. No waste-processing activities are conducted at the WIPP, except for minimum processing of site-generated wastes.

2.3 RETRIEVABILITY

All wastes placed into the WIPP are retrievable, with retrieval demonstrated, until such time as the pilot plant is converted to an operational repository for permanent disposal of wastes.

2.4 OPERATING LICENSE

Because it includes only low-level and intermediate-level ERDA TRU wastes and HLW experiments, the facility does not require an NRC license. However, the existing NRC regulations are used as a basis to develop a set of design criteria sufficiently stringent that it is anticipated the facility could be licensed when NRC regulations are developed, and if ERDA elects that option.

3. PROJECT ASSUMPTIONS

3.1 WASTE ORIGIN

The WIPP receives existing retrievably stored waste and newly generated waste from all ERDA sources, and experimental waste from commercial sources.

3.2 WASTE FORM

Only solid waste is stored at the WIPP. Until completion of the verification experiments and studies, only stable waste forms are stored.

3.3 WASTE RECEIVAL

The TRU facility is designed to handle 500,000 ft^3/yr of TRU waste on a one-shift-per-day, 5-day week. A maximum receival rate of 1,200,000 ft^3/yr is achieved by using three shifts per day. During the pilot-plant phase, the amounts of TRU waste will be limited to 1,000,000 ft^3.

The remotely handled waste facility is designed to receive 2600 canisters of RH waste per year (100,000 ft^3/yr) using one shift per day and 5 days per week. The receiving capacity of this facility can be increased to 6500 canisters per year if three operational shifts per day are used. During the pilot-plant phase, the amounts of RH waste will be limited to retrievable quantities.

Experimental high-level waste canisters are received over an extended time. The total number received does not exceed 300.

3.4 WASTE RETRIEVABILITY

Retrievability is demonstrated for all waste forms; however, the rate of retrieval need not match the rate of emplacement. Placement of remote-handled waste in sleeved holes is not mandatory, and survival of all canisters need not be guaranteed so long as an adequate retrieval method is available. The method of retrieval must be a reasonable, engineered system and not a concept requiring a "superhuman" approach.

3.5 DESIGN PHILOSOPHY

The waste-handling facilities have been designed for the existing packages in use today, but are not absolutely tied to those packages. Maximum flexibility within a realistic framework has been incorporated into each system.

Whenever questions arose with respect to safety, licensability, and public acceptance on a particular item, a practical, conservative engineering approach was used.

4. SITE AND FACILITY DESCRIPTION

4.1 SITE DESCRIPTION

The proposed site for the WIPP facility lies ~26 miles east of the city of Carlsbad, New Mexico, in an area known as Los Medaños "the dunes" (see Drawing 94532-C1). The surface features and drainage dip slightly to the southwest, while the underground salt beds to be used for the facility dip slightly to the southeast. As the name implies, the surface is comprised of sand dunes with local relief of from 5 to 15 ft, stabilized with scrub vegetation. Underlying the sand is a layer of caliche, then sandstone and dolomite to a depth of ~800 ft where the salt beds begin. The salt and anhydrite beds extend downward to ~4000 ft and are underlain by more sandstones and shales and eventually by basement rock.

The site is semiarid, receiving ~12 in. of rain per year. Little ground water exists in the potential water-bearing dolomite aquifers. Little surface development has occurred except for some oil and gas production and associated exploratory activities. The major surface activity is cattle grazing with ~9 cows per square mile, the authorized grazing density.

4.2 SURFACE LAYOUT

The layout of the surface facilities covers ~60 acres and is shown in detail on Drawing 94533-C1. An artist's rendition shows how the facility might look after construction (see Frontispiece). All buildings and surface facilities are included in a central fenced core area much smaller than the extent of potential underground development.

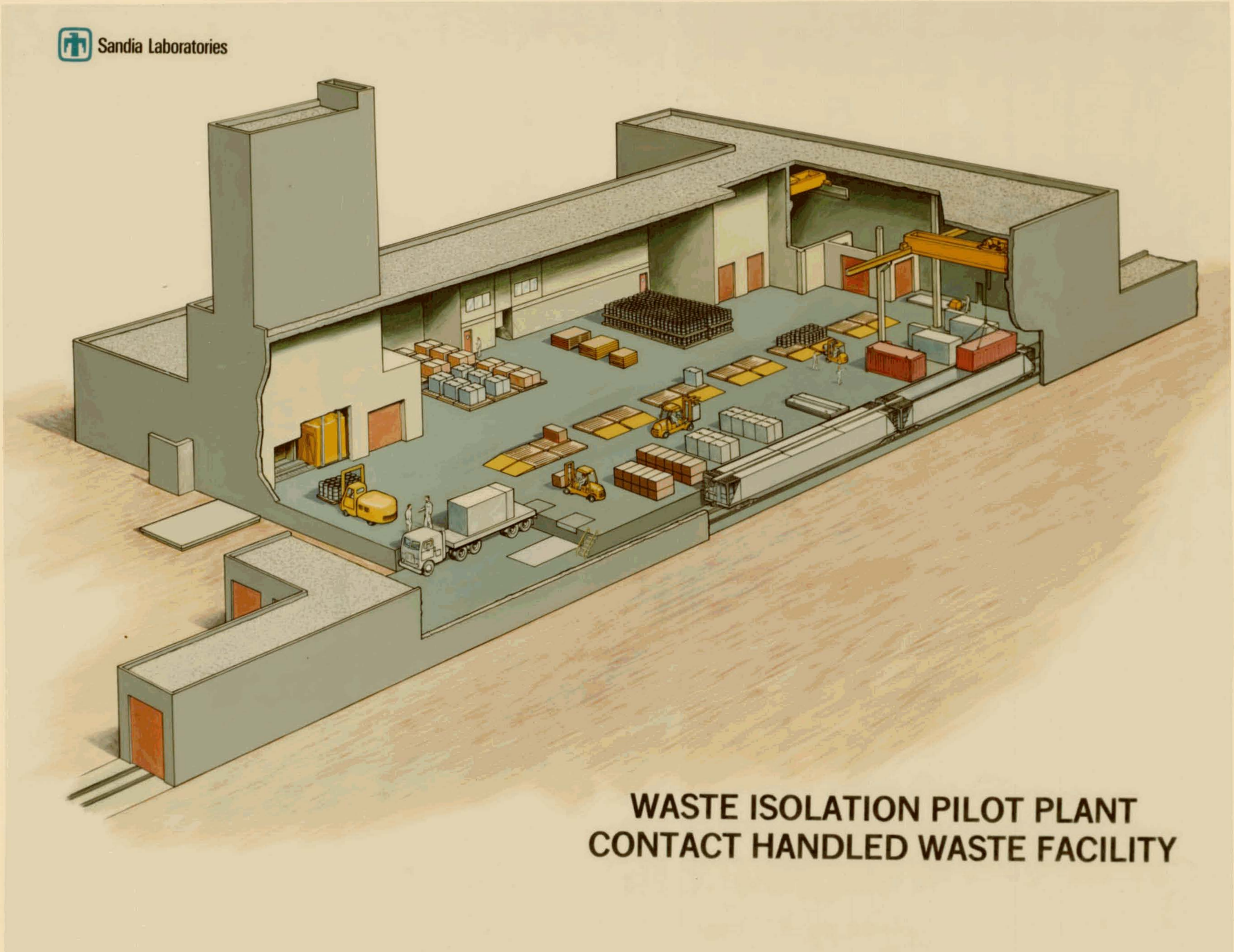
4.2.1 MAJOR FACILITIES

Major surface facilities consist of the Administration building (~36,000 ft^2), the TRU Waste building (~109,000 ft^2), and the RH Waste building (~48,000 ft^2).

The Administration building houses all general administrative support functions as well as the computer and facility monitoring center, the security headquarters, a site cafeteria, fire equipment, ambulance and medical station. Provisions for a 50-person theater and two smaller conference rooms are also included.

The TRU Waste building is a structure hardened for tornado and seismic protection and is used to receive, inspect and inventory all contact-handled TRU waste shipments to the site. The artist's pictorial cutaway of this facility gives a good representation of the facility and the activities carried out within. The building is maintained under slightly negative pressure with respect to outside ambience. Truck and rail shipments enter through air locks. All air discharged from the handling areas passes through a HEPA filter system. The design concept employs large open areas to maximize the ability to handle a variety of waste packages. A limited storage capacity is provided to accommodate material received during equipment maintenance and breakdowns. A capability to repair, overpack, and decontaminate limited quantities of damaged containers is incorporated.

The RH Waste building (see artist's rendition) is also a hardened structure and is used to receive, inspect, and inventory all wastes requiring remote handling. The design concept for this facility employs heavy-walled hot cells and remote-controlled equipment to unload the shipping casks and handle the waste canisters. Because of the uncertainty in the radiation and thermal output of the waste to be handled through this facility, characteristics of high-level commercial waste have been used for design; namely, about 4 kW of heat generation/canister with surface temperature $\sim 200^{\circ}C$ and surface dose rate of 10^6 rad/hr. The surface and underground facilities can accommodate canisters 2 ft in diameter by 16 ft long. This building, like the TRU facility, has a carefully controlled ventilation system that employs air locks, HEPA filters, etc. A design feature of this facility is the capability to add three more hot cells that attach to the existing clean cell and work through the same RH shaft to increase the throughput capacity, and to accommodate different waste types.



WASTE ISOLATION PILOT PLANT
CONTACT HANDLED WASTE FACILITY

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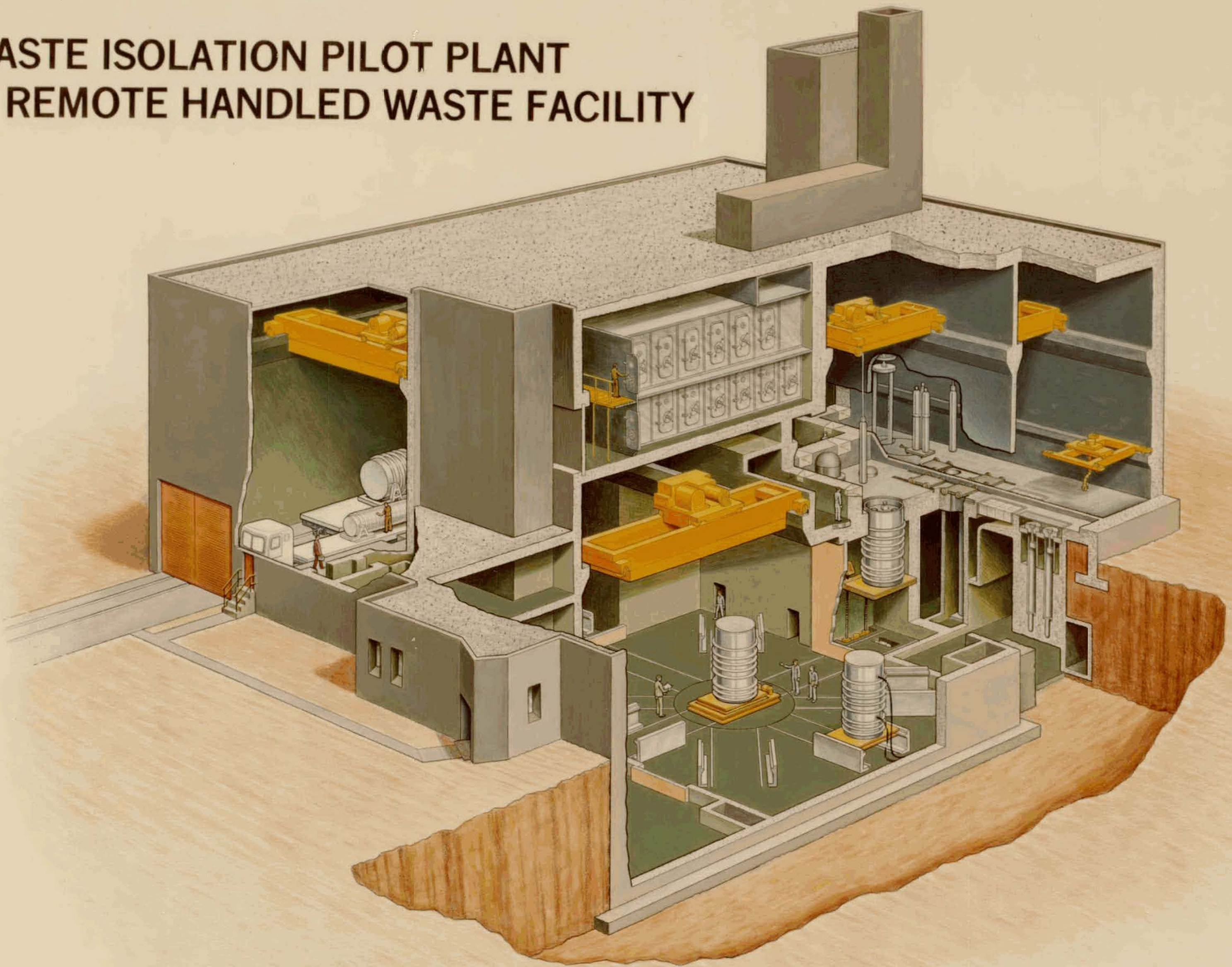
WASTE ISOLATION PILOT PLANT
REMOTE HANDLED WASTE FACILITY



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4.2.2 SUPPORT FACILITIES

Many support facilities are required; a listing of these support facilities, with a brief discussion of the major ones, follows:

Man/Materials Building (~10,000 ft^2). Provides a surface base for the underground construction and waste-handling personnel. Includes supervisory and engineering offices, first-aid and lamp rooms, and shower and change room facilities for those personnel directly involved in the underground operations.

Warehouse/Shops (~18,000 ft^2). Provides storage space for expendable supplies and space for carpenter, sheetmetal, and other craft shops required for facility maintenance.

Vehicle Maintenance Building (~2300 ft^2). Provides for minor repair and service of site vehicles.

Emergency Power Building (~10,000 ft^2). A hardened structure for three 2.5-MW diesel emergency-power generators.

RH and TRU Hoist Building (~7000 ft^2). Located underground to provide a hardened structure for the two hoists that lower waste into the mine.

Suspect Waste/Laundry Building (~5700 ft^2). A hardened structure for laundering the anti-contamination clothing used in the waste-handling operations and a treatment system for on-site-generated solid and liquid radwaste.

Mine Storage Filter House (~25,000 ft^2). A hardened structure to house the rough, medium and HEPA filter system and the fans for moving ~200,000 cfm of air through the waste storage areas.

Man/Materials Hoist Building (~5000 ft^2)

Mine Construction Exhaust Fans

Water Treatment and Storage Facilities (200,000 gals) (2 each)

Water Pumphouse (2 each)

Sewage Treatment Plant

Distribution/Collection Systems for:

- Water
- Power
- Sewage
- Liquid radwaste
- Communications
- Environmental data
- Facility monitor and contr~~

4.2.3 ACCESS AND UTILITIES

Highway access to the site is by approximately 12 miles of new road coming from the north off U.S. Highway 62/180. Rail access is from the southwest from the Duval AT&SF mine spur, with about 8 miles of new railroad construction required.

Potable water for the site comes from the Double Eagle Water System about 30 miles to the north. Telephone lines also come from the north. Both water and communications follow the road right-of-way. A new, 11-mile-long, 115-kV overhead transmission line runs in from the west to supply the approximately 20 MW of power required (reference Drawing 94532-C1, Vicinity Map).

4.3 UNDERGROUND LAYOUT

The areal extent and general layout of the planned underground openings are shown in Drawing 94566-A1, Composite Plan and Areal Extent of Underground Openings. The artist's perspective gives a more graphic idea of the underground development.

4.3.1 UNDERGROUND ACCESS

Personnel, material, and ventilation access to the underground part of the facility is through five shafts. Two of the shafts are for waste transport--the TRU shaft (17 ft diam), and the RH shaft (8 ft diam). Two more are for ventilation exhaust--the mine storage ventilation shaft (14 ft diam), and the mine construction ventilation shaft (14 ft diam). The fifth shaft (23 ft diam) is for men and mine materials, equipment and ventilation intake. Except for the TRU shaft, all shafts go to the RH level. The RH shaft passes through, but does not connect with, the TRU level.

4.3.2 WORKING LEVELS AND MINE LAYOUT

There are two working levels in the mine. The upper level (~2100 ft deep) is used to store TRU waste; and the deeper level (~2700 ft deep) is used to store the remote-handled, heat-producing waste and to conduct high-level waste experiments. Each level is developed in essentially the same manner, using a four-entry system. Four main parallel drifts extend away from the shaft for a distance of ~1000 ft to where the storage rooms are constructed. This distance ensures that the rock stress induced by excavation does not affect the long-term stability of the shafts. The two outside drifts of the four are for man and equipment access as well as for fresh air routes to the work areas. The two inner drifts of the four provide ventilation return, one for waste-storage air, and one for construction air.

4.3.3 MINING METHOD AND RATES

Except for the initial mining off the bottom of the shafts to provide a work and assembly space, all mining is accomplished by use of continuous mechanical, electrically driven mining machines. By using mechanical systems, the problem of handling explosives is eliminated, and the shock-induced fracturing of the salt is minimized.

It is planned to conduct mining and waste-handling operations concurrently. The mined salt is stored on the surface until it is determined whether the facility will be converted to a full repository. After this has been determined, the salt not required for backfill will be disposed of by one of the methods discussed in Addendum B.

4.4 WASTE STORAGE OPERATIONS

4.4.1 TRU WASTE STORAGE

The TRU waste to be handled through the TRU facility has a sufficiently low surface dose rate that it can be contact-handled. Containers are checked for transferable α contamination and cleaned or overpacked if necessary, then loaded by forklifts onto large reusable pallets, lowered to the storage level, transported through the mine to the storage site, where they are unloaded from the pallets and stacked in the room, again by forklifts. The reusable pallets are returned to the surface facility for reloading.

During pilot-plant operations, the rooms are not backfilled to facilitate retrieval, if that should become necessary. If the facility is beyond the pilot-plant phase and into repository operations, the extra space in the rooms will be filled with crushed salt.

4.4.2 REMOTE-HANDLED WASTE STORAGE

The RH waste is handled by remotely operated equipment inside hot cells or in shielded containers. The shipping cask, weighing as much as 110 tons, is passed through an air lock into the building, where it is prepared as required and then attached to the hot cell for unloading. Waste canisters are removed from the shipping cask by remotely operated equipment, inspected, decontaminated, overpacked if damaged, and lowered to an underground shielded transfer cell. There, canisters are unloaded from the shaft conveyance and loaded into a shielded transporter for transport to the storage location.

4.4.3 RETRIEVAL OPERATIONS

Retrieval of TRU waste from the unbackfilled rooms is essentially a reversal of the emplacement sequence. Where backfill is present it must be broken up if it has caked and removed before the waste packages can be removed. Any damaged packages are repaired or overpacked at the storage site prior to transporting through the mine.

The RH waste placed in contact with the salt is retrieved using a special overcoring machine. A sequence of operations is employed to open the hole to the top of the waste canister, overcore the canister, remove the core and canister to the shielded transfer cell at the base of the shaft, and there place it into a new canister for transport up the shaft.

4.5 SUPPORT OPERATIONS

A wide variety of activities supports storage operations. Clerical activities include purchasing, payroll, and inventory. Electricians, carpenters, plumbers mechanics, operators and miners provide craft support. Technical support such as computer operations programming, electronics, instrument repair, electrical, mechanical, structural engineering for plant support, mining engineering, health-physics, laboratory, are all needed.

To support a one-shift-per-day waste-handling and storage operation, a site population of ~350 to 400 is expected (see Addendum A). If a second or third shift is necessary, ~150 people per shift will be needed.

5. COST SUMMARY

A cost estimate has been prepared that is based upon the conceptual design described in the report. The WIPP conceptual design capital cost estimate is $330 million and includes engineering, design and inspection, land acquisition and land rights, procurement, construction, installation, escalation and contingency. A summary is shown in Table I. 1-5-1.

The major assumptions for this cost estimate were

a. The cost estimate is based upon the conceptual design described in this report

b. The basic cost estimate (without escalation) is based on April 1977 prices for labor, materials and equipment

c. An escalation rate of 8 percent/yr compounded annually was applied to construction and standard equipment costs

d. An item-by-item engineering design and inspection and contingency cost estimate was performed (see Tables I. 1-5-2 and I. 1-5-3)

A preliminary obligation and costing schedule was prepared using the information in the conceptual design cost estimate and the construction schedule (Drawings 94531-S1 through -S3), and is summarized in Table I. 1-5-4.

Additional information on the cost estimate is contained in Addendum C, Cost Work Sheets.

TABLE I. 1-5-1

WIPP Conceptual Design Capital Cost Estimate
($ in thousands)

I. Engineering Design and Inspection (@ ~15 percent of construction costs)			32,000
II. Land and Land Rights			33,000
III. Construction Costs			153,330
Improvements to land		10,230	
Roads	3,760		
Railroad	4,580		
Site Work and Site Improvement	1,890		
Buildings		70,430	
TRU Waste Surface Facility	20,200		
RH Waste Surface Facility	29,200		
Administration Building	4,300		
RH & TRU Hoisthouse and Tunnels	4,980		
M/M Hoisthouse	880		
Mine Storage Filter Building	5,060		
M/M Building	990		
Emergency Power Building	1,640		
Suspect Waste/Laundry Building	1,040		
Warehouse/Shops	1,130		
Misc. Buildings	1,010		
Other Structures		55,260	
TRU Shaft	6,280		
RH Shaft & Transfer Cell	8,620		
M/M Shaft	11,310		
TRU-RH Ventilation Shaft	4,030		
Construction Ventilation Shaft	4,710		
TRU Level (Initial Development)	7,070		
RH Level (Initial Development)	13,240		
Utilities		17,410	
Water	8,490		
Electrical	3,150		
Telephone	1,440		
Sanitary Sewer	390		
Storm Sewer	200		
Process Waste System	240		
Radiation Monitor System	1,930		
Misc. Alarm & Control Systems	670		
Misc. Tanks	900		
IV. Standard Equipment			32,170
Generators		3,650	
Computer System		2,000	
Mining Equipment		15,980	
Surface Equipment		3,540	
Waste-Handling Equipment		7,000	
V. Construction Management			6,000
	SUBTOTAL		256,500
VI. Contingency (~30%)			73,500
	TOTAL		330,000

TABLE I. 1-5-2

WIPP Conceptual Design Engineering Design and Inspection Estimate
($ in thousands)

	Cost	%	Fee	
Construction				27, 240
Improvements to Land	10, 230	15	1, 530	
Building				
TRU Waste	20, 200	20	4, 040	
RH Waste	29, 200	20	5, 840	
Administration Building	4, 300	18	770	
RH & TRU Hoisthouse & Cable Tunnels	4, 980	15	750	
M/M Hoisthouse	880	15	130	
Misc. Storage Filter Building	5, 060	20	1, 000	
M/M Building	990	15	150	
Emergency Power Building	1, 640	20	330	
Suspect Waste/Laundry Building	1, 040	18	190	
Warehouse/Shops	1, 130	15	170	
Miscellaneous Buildings	1, 010	15	150	
Other Structures				
TRU Shaft	6, 280	18	1, 130	
RH Shaft & Underground Transfer Cell	8, 620	20	1, 720	
M/M Shaft	11, 310	15	1, 700	
TRU-RH Vent. Shaft	4, 030	18	730	
Construction Vent. Shaft	4, 710	15	710	
TRU Level (Initial Development)	7, 070	15	1, 060	
RH Level (Initial Development)	13, 240	18	2, 380	
Utilities				
Process Waste, Rad Monitor, Alarms and Control Systems	2, 840	20	570	
Other Systems	14, 570	15	2, 190	
Standard Equipment	32, 170	15		4, 825
			TOTAL	32, 065
			Say	32, 000

TABLE I. 1-5-3

WIPP Conceptual Design Contingency Estimate
($ in thousands)

		Cost	%	Contingency	
I.	Engineering, Design & Construction	32,000	25	8,000	8,000
II.	Land and Land Rights	33,000	35	11,500	11,500
III.	Construction				44,190
	Improvements to Land	10,330	15	1,530	
	Buildings				
	TRU Waste Surface Facility	20,200	35	7,070	
	RH Waste Surface Facility	29,200	35	10,220	
	Administration Building	4,300	25	1,075	
	RH & TRU Hoisthouse and Cable Tunnels	4,980	25	1,245	
	M/M Hoisthouse	880	15	130	
	Mine Storage Filter Bldg.	5,060	35	1,770	
	M/M Building	990	15	150	
	Emergency Power Bldg.	1,640	25	410	
	Suspect Waste/Laundry Bldg.	1,040	35	360	
	Warehouse/Shops	1,130	15	170	
	Miscellaneous Bldg.	1,010	15	150	
	Other Structures				
	TRU Shaft	6,280	30	1,890	
	RH Shaft & Underground Transfer Cell	8,620	35	3,020	
	M/M Shaft	11,310	25	2,830	
	TRU-RH Vent. Shaft	4,030	25	1,000	
	Construction Ventilation Shaft	4,710	25	1,180	
	TRU Level (Initial Development)	7,070	30	2,120	
	RH Level (Initial Development)	13,240	30	3,970	
	Utilities				
	Process Waste, Rad Monitor Alarms & Control Systems	2,840	35	990	
	Other Systems	14,570	20	2,910	
IV.	Standard Equipment				8,010
	Generators	3,650	20	730	
	Computer System	2,000	15	300	
	Mining Equipment	15,980	25	4,000	
	Surface Equipment	3,540	15	530	
	Waste-Handling Equipment	7,000	35	2,450	
V.	Construction Management	6,000	25	1,500	1,500
				TOTAL	73,200
				Say	73,500

[redacted]

TABLE I. 1-5-4

WIPP Obligation and Costing Schedule
($ in thousands)

	FY77	FY78	FY79	FY80	FY81	FY82	FY83	FY84	Total
Engineering Design & Inspection	2,000	8,000	8,000	8,000	2,500	2,500	1,000	-	32,000
Land & Land Rights	4,000	2,500	26,500	-	-	-	-	-	33,000
Construction	-	-	39,300	49,000	64,000	1,030	-	-	153,330
Standard Equipment	-	5,000	3,600	13,000	-	10,570	-	-	32,170
Construction Management	-	-	1,000	1,500	1,500	1,500	500	-	6,000
Subtotal	6,000	15,500	78,400	71,500	68,000	15,600	1,500	-	256,500
Contingency	-	6,500	23,600	20,500	18,000	4,400	500	-	73,500
Total (obligations)	6,000	22,000	102,000	92,000	86,000	20,000	2,000	-	330,000
(Costing)	2,000	13,000	48,000	70,000	88,000	67,000	35,000	7,000	330,000

6. SCHEDULE SUMMARY

A tentative schedule (see Figure I. 6-1) for the architectural-engineering design of the facility, plus the procurement and construction, shows the most important milestones. More detailed engineering and construction schedules are contained in Drawings 94565.

Program Evaluation and Review Technique (PERT) has been used throughout the WIPP program and will be expanded to detail the Title I, Title II, procurement and construction activities.

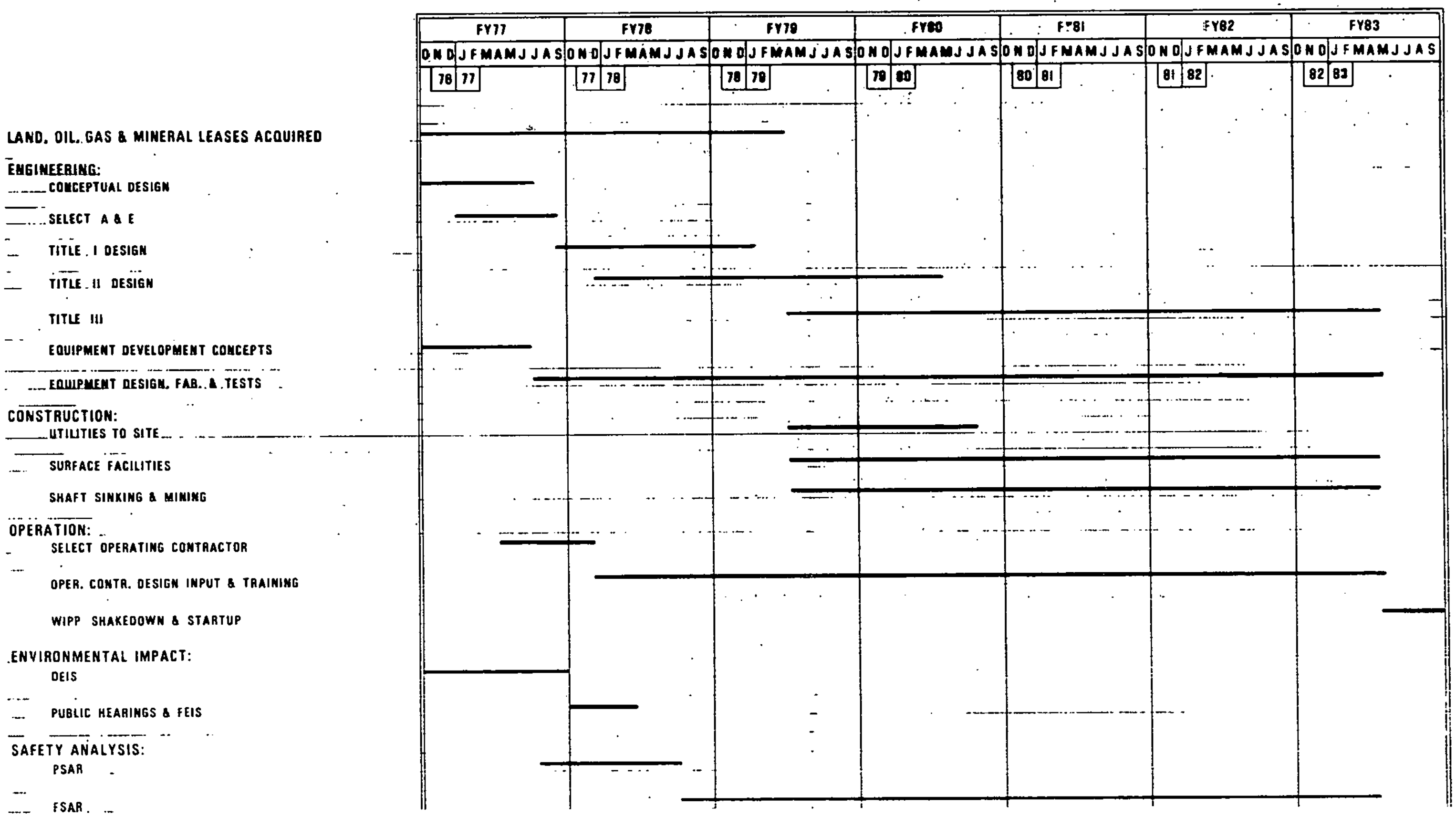


Figure I. 6-1. WIPP facility schedule summary (4/15/77)

1. GENERAL DESIGN CONSIDERATIONS

The charter of the Waste Isolation Pilot Plant (WIPP) is to develop a facility to receive, inspect, emplace and store in a retrievable fashion ERDA contact-handled transuranic waste (TRU), ERDA remote-handled intermediate-level waste (ILW) and conduct experiments using remote-handled high-level waste (HLW).

1.1 WASTE QUANTITIES

No firm quantities of the different types of waste, delivery rates or standard package size exist throughout the waste management community. The assumptions used as a basis for the conceptual design are detailed in subsequent sections. However, the facilities have been designed with maximum flexibility in mind to anticipate future changes and are not restricted to the design assumptions. Further, the facilities are designed to handle the maximum expected quantities and not only the quantities received during the pilot-plant phase. This will allow conversion to full-scale operation without major revisions.

1.1.1 ERDA CONTACT-HANDLED TRANSURANIC WASTE

This type of waste is hereafter referred to as TRU waste. Anticipated ERDA TRU waste shipped in the year 1986 is 500,000 ft^3, which is the design capacity per year on a one-shift-per-day, 5-day-week operation. By working two shifts a day, ~900,000 ft^3 could be handled; and on a three-shift operation ~1,200,000 ft^3/yr.

These quantities are assumed to arrive in drums, boxes and M3 bins, with ~75 percent arriving by rail and 25 percent by truck. Assuming 500,000 ft^3 per year and processed waste, 625 truck shipments and 730 ATMX rail shipments would have to be handled each year. For sizing the facility, it was assumed that all waste would be processed (incinerated and fixed). The assumed shipping configurations are as shown in Figs. II.1-1, -2, -3.

1.1.2 ERDA REMOTE-HANDLED INTERMEDIATE-LEVEL WASTE

Hereafter, the various forms of high β-γ TRU waste requiring remote handling will be referred to as RH waste. The basis for the assumed quantities is much more arbitrary for remote-handled waste than for TRU waste. Little is defined as to waste form, characteristics, or type that is to be stored at the WIPP. The numbers used are 2600 canisters per year, 2 ft in diameter and 15 ft long, for a total of ~100,000 ft^3/year. This quantity represents a one-shift-per-day, 5-day-week operation. With two shifts a day the rate would be 4700 canisters, and with three shifts, 6500 canisters a year. This also assumes one aboveground hot cell and one underground transfer cell. Plans allow expansion of the surface facilities to four hot cells and the underground loading to four or more loading stations.

It has been assumed that 75 percent would arrive by rail and 25 percent by truck. For a one-shift operation approximately 640 truck shipments and 280 rail shipments would be handled by the facility. The assumed shipping configurations are shown in Figs. II.1-4 and -5.

1.1.3 REMOTE-HANDLED HIGH-LEVEL WASTE EXPERIMENTS

Hereafter, this category of waste will be referred to as RH experiments. The experimental program has not been totally defined; however, preliminary scoping indicates that ~300 canisters of waste should be sufficient. This is the number that has been used for planning. This waste would be handled through the same hot cell as the RH waste and will arrive at the facility over several years; hence, no real impact on throughput capability is expected. Assumed shipping configurations are as shown in Figs. II.1-6 and -7.

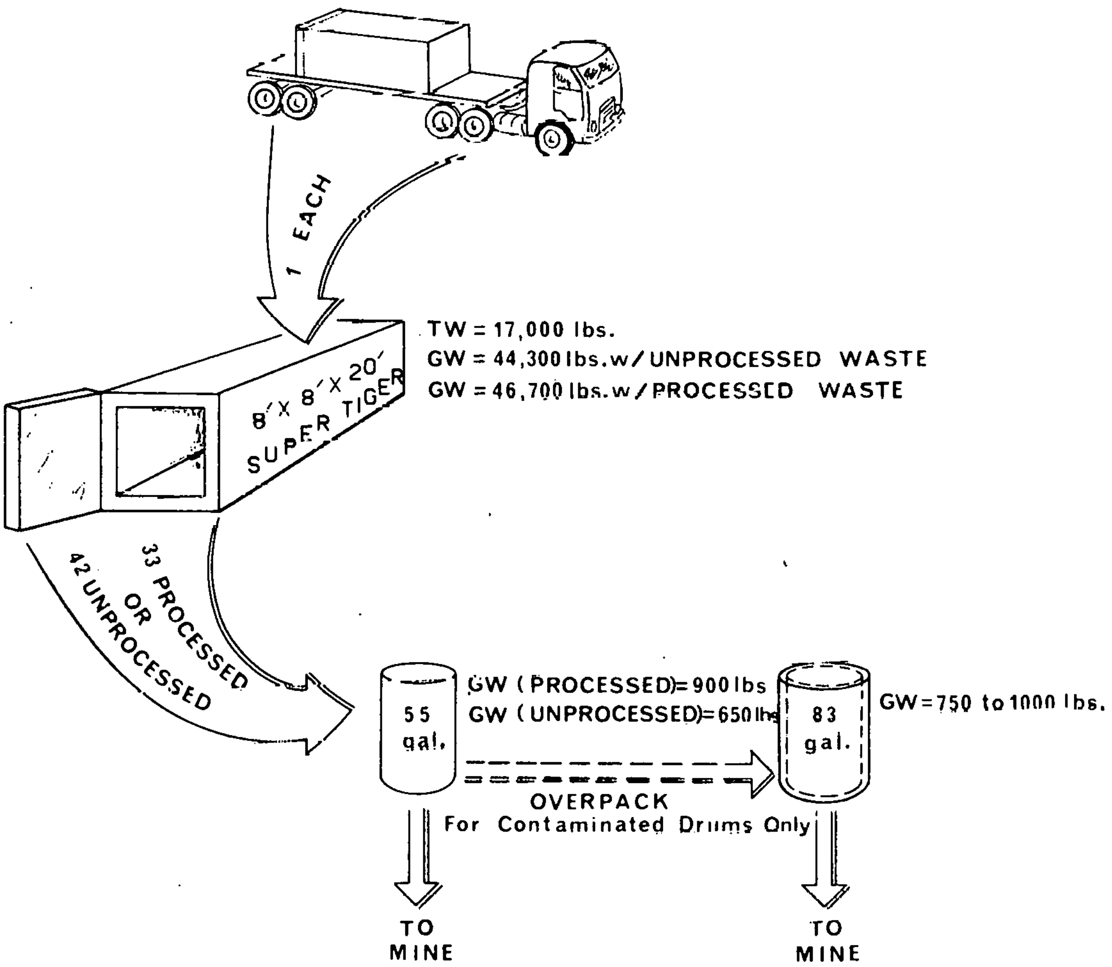


Figure II. 1-1. TRU waste received by truck

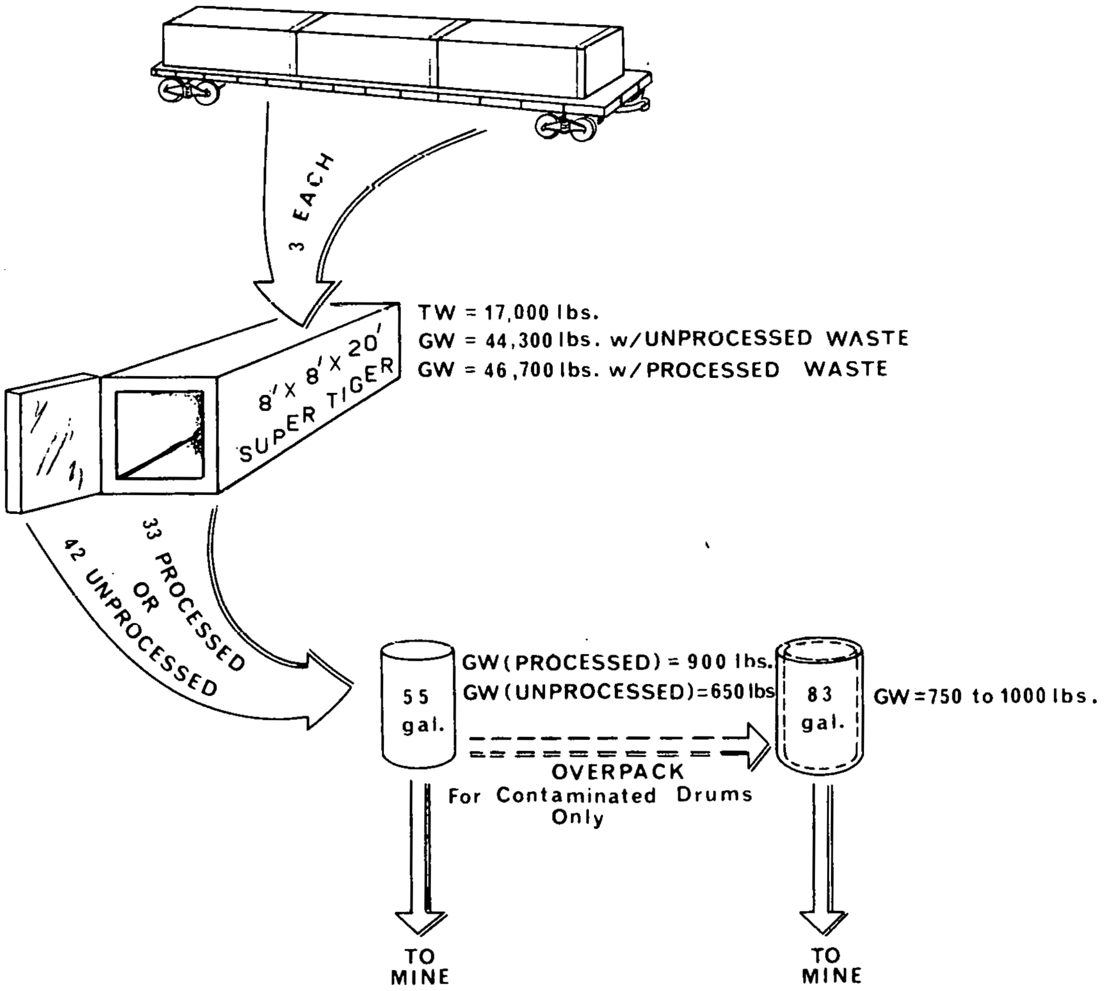


Figure II. 1-2. TRU waste received by rail

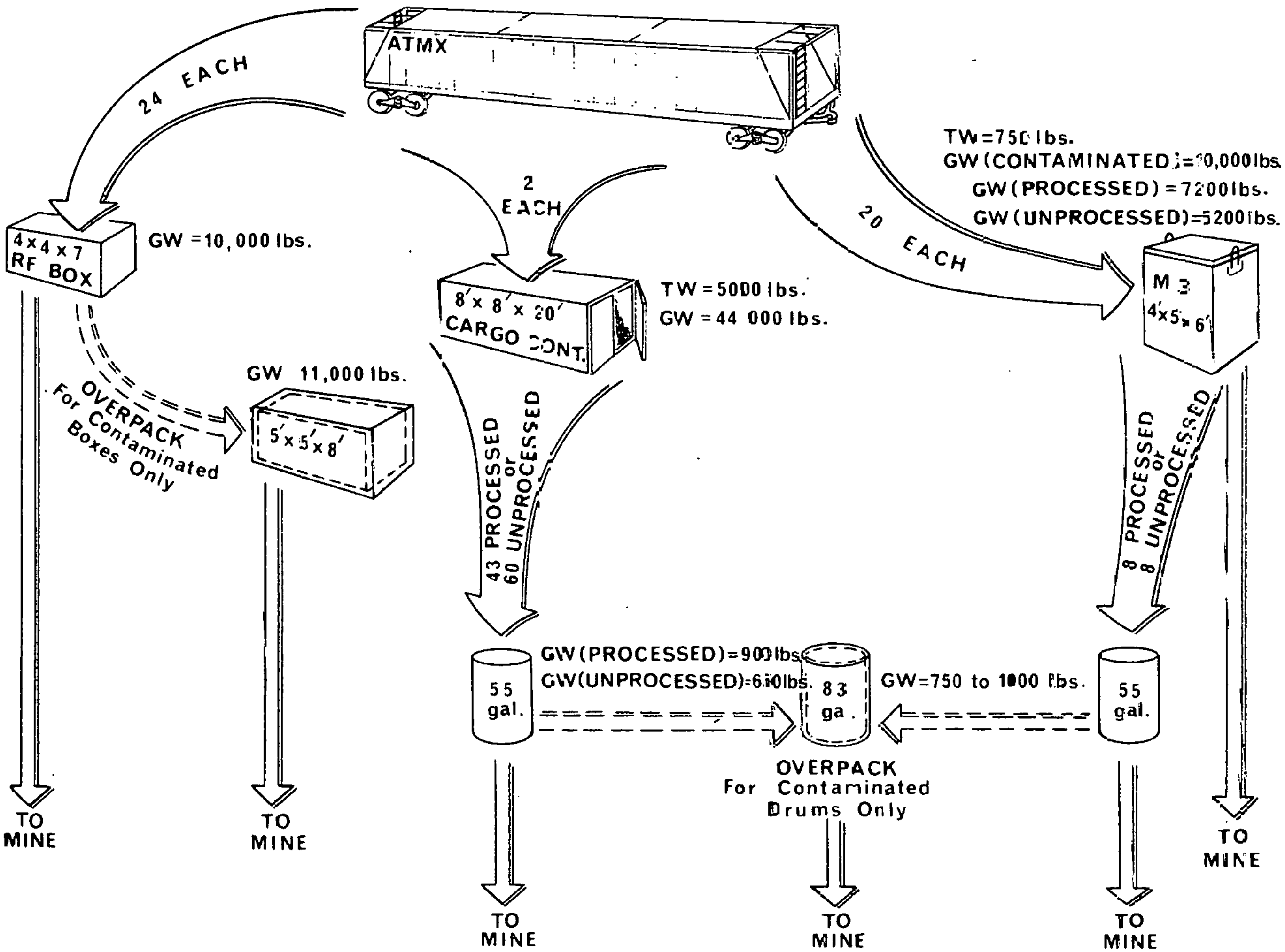


Figure II. 1-3. TRU waste received by ATMX

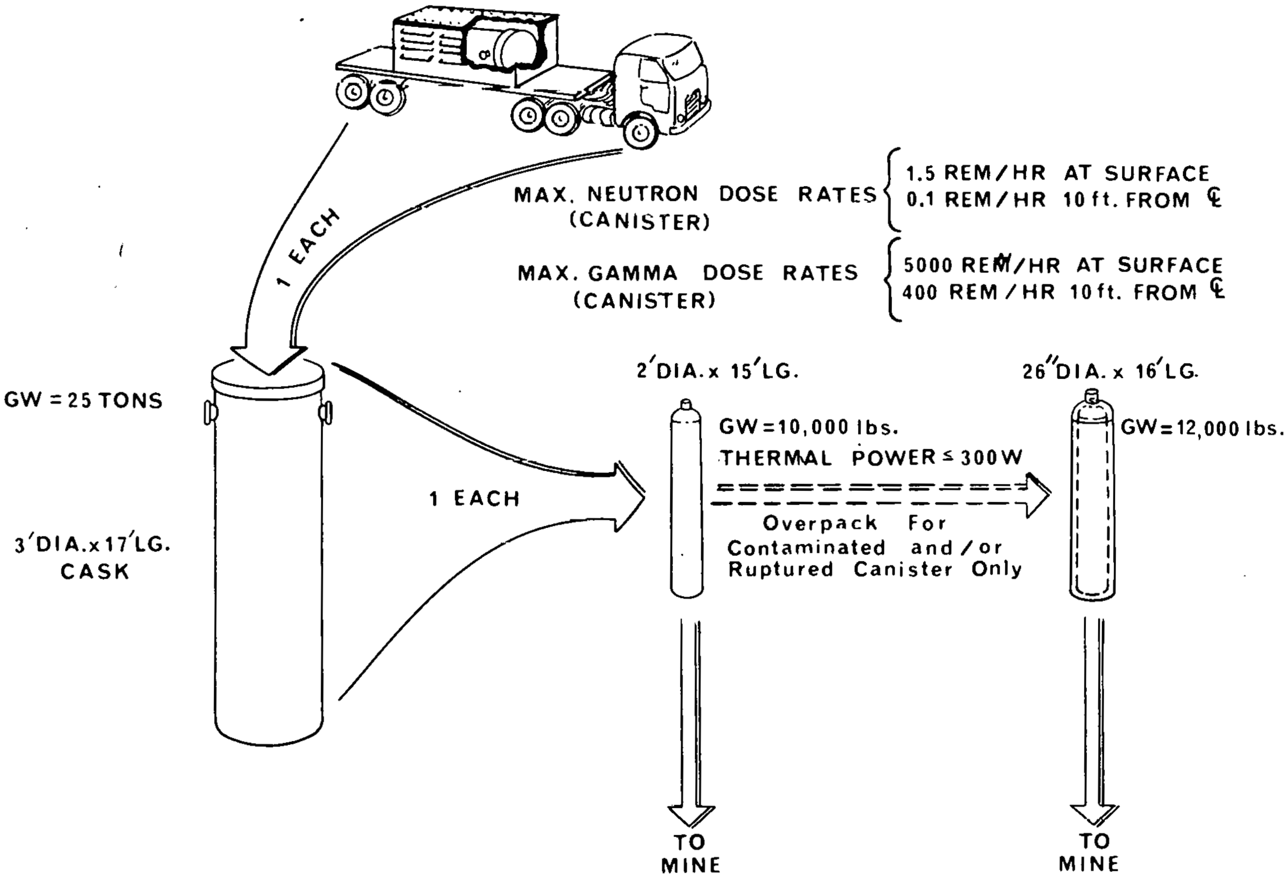


Figure II. 1-4. ERDA remote-handled waste received by truck

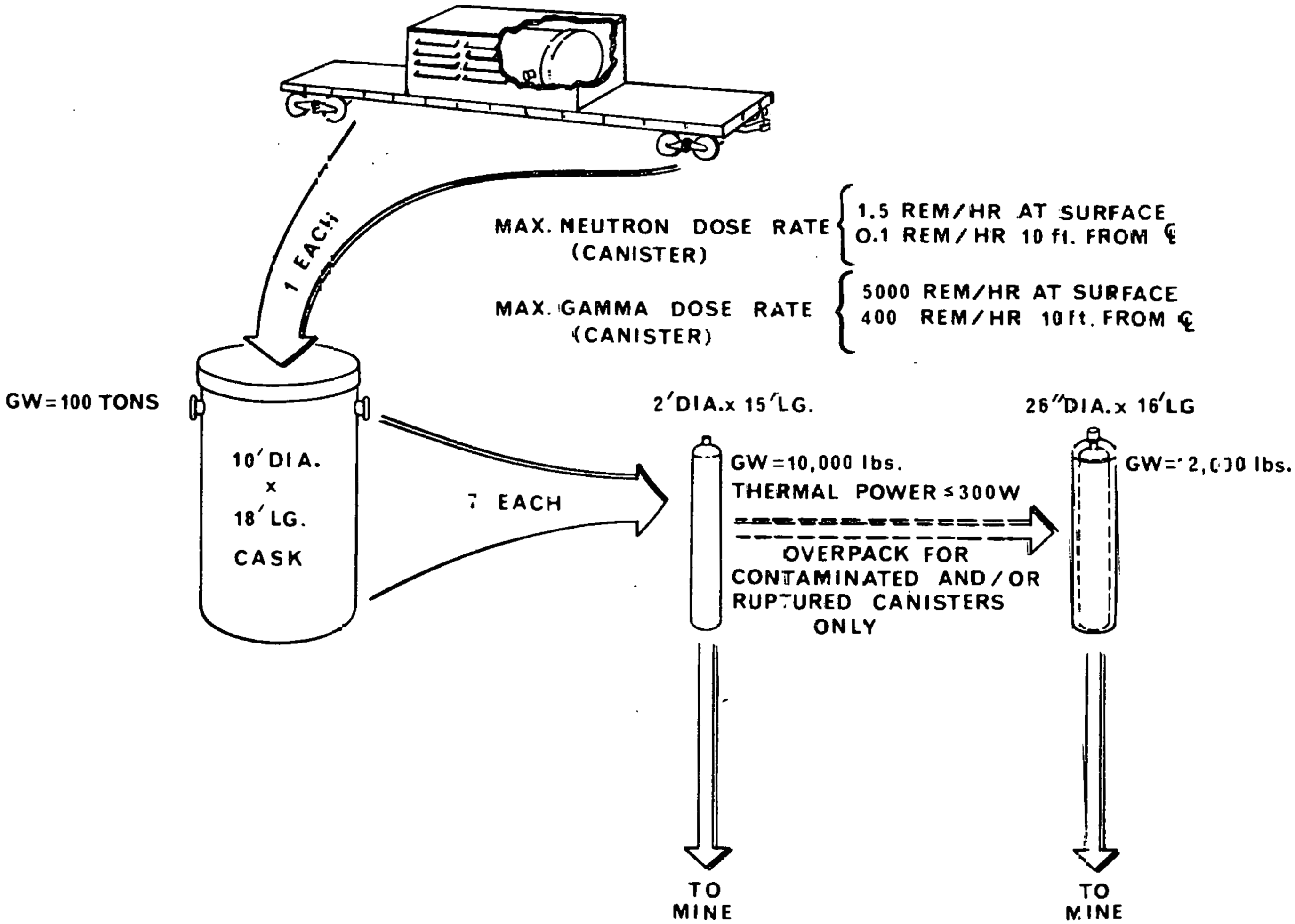


Figure II. 1-5. ERDA remote-handled waste received by rail

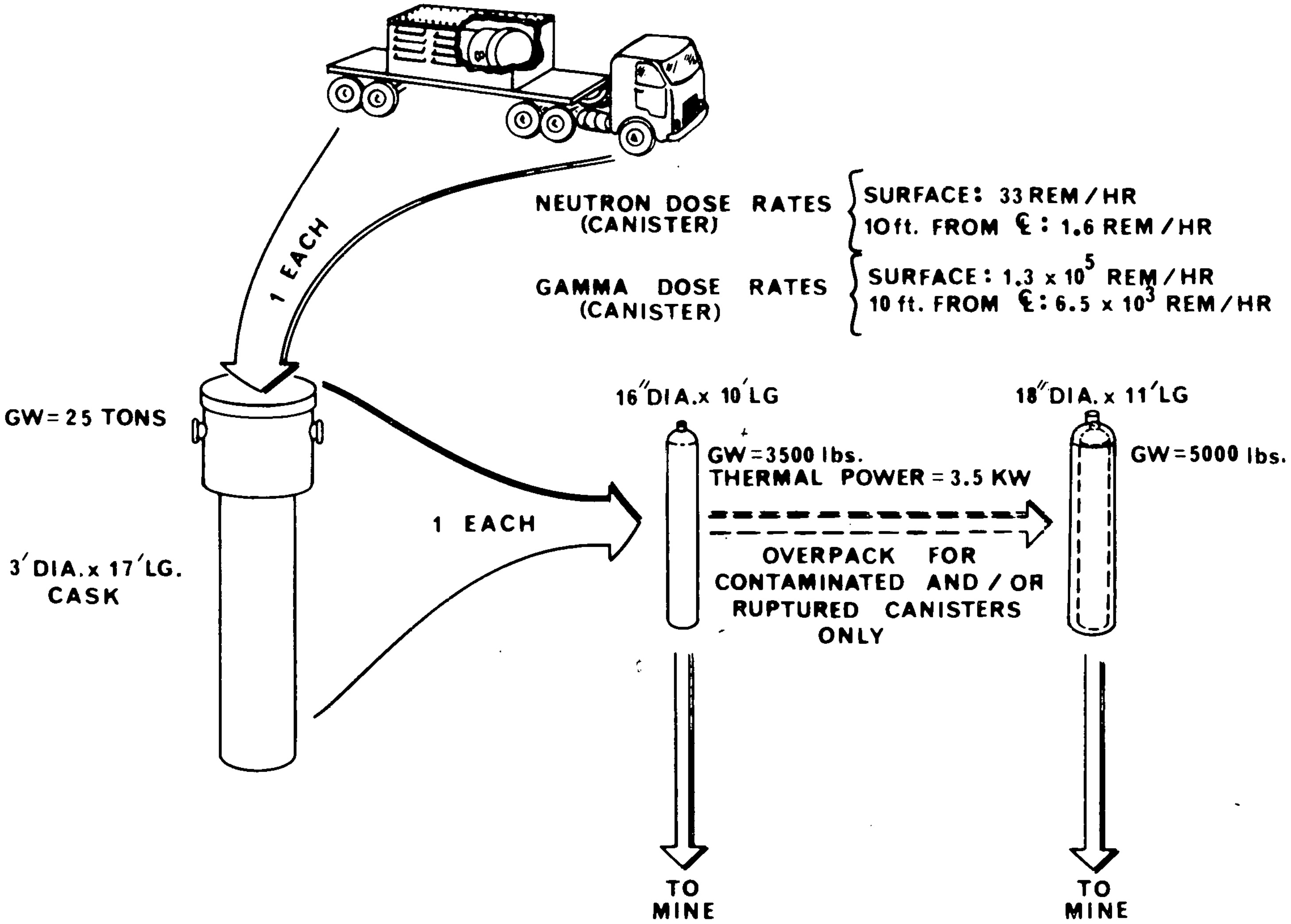


Figure II. 1-6. High-level waste experiments received by truck

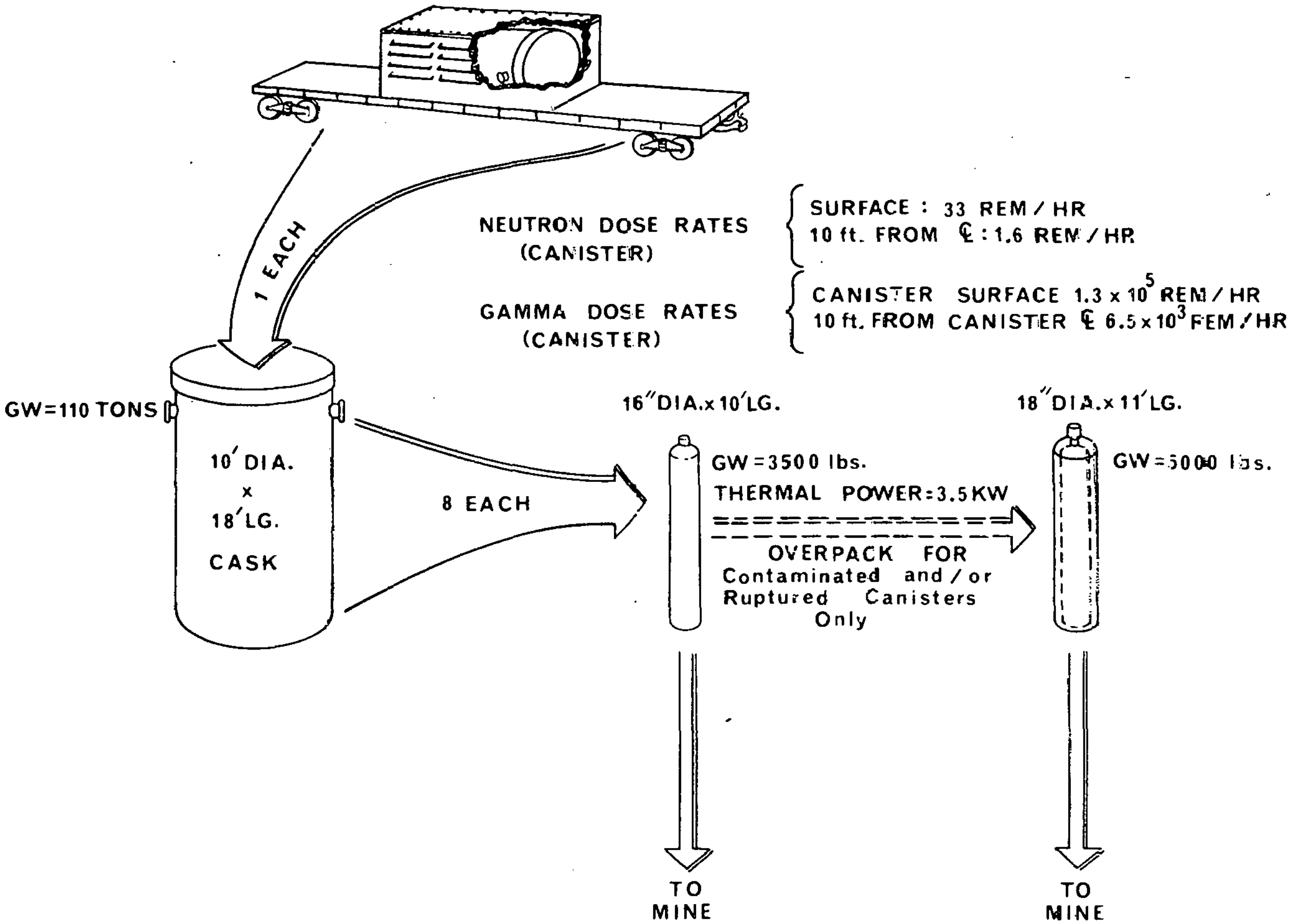


Figure II. 1-7. High-level waste experiments received by rail

1.2 SAFETY CONSIDERATIONS

Safety considerations for this facility include: industrial, radiological, and mining. Industrial safety is governed by appropriate ERDA and/or OSHA standards, and radiological safety is controlled by ERDAM Chapters 0511, 0513 and 0524. There is no requirement now to comply with the existing NRC regulations; however, these regulations have been examined and appropriate sections will be incorporated into the Design Criteria for Titles I and II design to facilitate licensing at a later time, should a decision for licensing be made. Mining safety is effected by using the MESA code for Metal and Non-Metal Mine Health and Safety, as well as the New Mexico Mine Safety Code for all mines. Conflicts may arise between the various codes, and a specific safety code will be developed for the WIPP to resolve these differences. A preliminary review of the State and MESA safety code to extract the appropriate sections is listed in Addendum L.

1.2.1 AREA MONITORING

The entire facility, surface building, underground development and the immediate surrounding area are instrumented and the collected real-time data fed to a central monitor and control room. This makes the instantaneous status of the facility available for decision-making in case of accident or for assuring a continuing safe operation. The real-time data are stored in the site computers and are available for display. Examples of parameters to be monitored are: air quality in the mine, background radiation levels, temperature, ventilation flow, etc. More details of the instrumentation system are found in Section 4.2.7.

1.2.2 SURFACE FACILITIES

The primary means to minimize radiation exposure of operating personnel is to use physical safeguards such as remote-handling equipment and shielding to the maximum extent. Streamlined operating procedures that minimize operator exposure time are used to augment physical precautions. The entire facility design and operation are tailored to keep exposure levels as far below 20 percent of the ERDAM 0524 permissible dose equivalent as possible.

1.2.2.1 Compartmentalization--Areas where contamination potentials are highest are separated by compartmentalization. In addition to physical separation, the ventilation system is designed to minimize dispersal of contamination.

1.2.2.2 Off-Site Release--At least two containment barriers are maintained between the waste product and the environment at all times. These barriers include:

- waste form
- waste containers
- waste shipping containers
- waste-handling buildings
- HVAC filters

Multiple stages of HEPA filters are provided for air discharged from all waste-handling areas. All waste facilities operate at negative pressure to ensure movement of air into, rather than out of, each facility. All waste-handling buildings are hardened for tornado winds and missiles, and for earthquakes.

1.2.2.3 Radiological Release Standards--Airborne concentration limits in unrestricted areas that the WIPP is designed to meet are conservatively estimated at:

Alpha Emitters:	1 pCi/m^3
β-γ Emitters:	30 pCi/m^3

These limits are based on the most restrictive isotopes now assumed to be discharged to the radwaste system. Concentration limits will be redefined during the Title I and II design efforts when source terms are verified. The design of liquid radioactive waste treatment systems as described in Section 4.11.1 and elsewhere is adequate to allow release from the Suspect Waste Pond to the unrestricted area unless the waste source term is greatly altered during the Title I and II design effort.

1.2.3 UNDERGROUND FACILITIES

Mining operations have higher risks and more safety problems than do most industrial operations. Every aspect of the design and operation of the underground portion of this facility was thoroughly examined to assure safety.

1.2.3.1 Separation of Mining and Waste Handling--The mining and waste handling are separated to minimize congestion and limit the number of people exposed to any accident-induced environment.

1.2.3.2 Waste Handling--As in the surface facility, operations are designed to minimize operator exposure to waste packages, and shielding is used where necessary to minimize operator exposure. Where high β-γ wastes are emplaced in holes drilled in the salt, equipment reliability is a major design factor. Remote viewing is used where possible to minimize exposure.

The ventilation system is monitored to ensure that the waste storage areas are at slightly negative pressure with respect to other underground areas. The brattices built to separate the mining and waste area air are permanent structures. Except in rare occurrences, persons will not work downstream from waste storage areas. Details of the ventilation plan can be found in Section 4.1.

1.2.3.3 Mining--The mining is done using mechanical miners. Mechanical mining produces fewer safety problems than do conventional drill and blast methods.

The mine design is based on the best information available and is directed toward maximizing stability. A multiple-entry concept is employed to provide redundant escapeways for operating personnel as well as to eliminate congestion. Main access underground is by the man and materials shaft; the construction vent shaft is the main escape shaft. The TRU and the waste storage vent shafts can, depending upon accident circumstances, be used as secondary escape shafts. The hoists and ventilation system are connected to the emergency power net to ensure their operation through any emergency.

Underground communications are redundant to ensure that all persons underground can be reached. Safety equipment is placed for quick access and includes an ambulance-type vehicle, a foam fire-fighting system, standard mine rescue equipment, and rad-safe equipment.

Instrumentation will be included to monitor mine air for the presence of toxic and flammable gases.

1.3 QUALITY ASSURANCE AND CLASSIFICATION OF FACILITIES

1.3.1 QUALITY ASSURANCE PROGRAM

The WIPP Quality Assurance Program assures adequate quality control over design, procurement, construction, and operation of systems and equipment important to safety. Inspection and maintenance records must be kept for periodic review by Quality Assurance. The Quality program also assesses incoming waste material to assure conformance with criteria established for the site. The quality assurance program is established to implement ERDA requirements and avoid possible future conflict with NRC regulations concerning waste disposal facilities. These programs are structured to establish quality level requirements based on a consequence of failure analysis.

Quality Assurance Programs provide for quality control, verification, and monitoring of:

a. Design
b. Hardware and Equipment Procurement
c. Construction Procurement
d. Construction
e. Operation and Maintenance

Since these areas encompass a wide variety of disciplines, slightly different approaches are needed to implement the Quality Programs.

1.3.1.1 Design--The design quality assurance program assures that design requirements are correctly translated into specifications, drawings, procedures, and instructions. Proper documentation of design calculations is verified, especially for safety considerations. Assumptions about, and application of, adequate safety factors are evaluated. Design reviews, alternate or simplified calculations, and test programs verify design adequacy. Such things as design interfaces and design changes are monitored for conformance with the overall quality requirements.

1.3.1.2 Hardware and Equipment Procurement--Both special-designed items and standard items of hardware and equipment are included in the procurement activity. Proper and safe function of hardware and/or equipment must be verified. Stringent adherence to appearance, finishes, close tolerances, processes, procedures, etc., is emphasized when such features are vital to safety. Quality monitoring is done by reviewing inspection data, test results, certifications, process specifications, procedures, etc., and observing contractor plant operations.

The desirable quality level for hardware and equipment important to safety is generally above that required for normal commercial use.

A quality program requirement conforming to ERDA's QC-1 is imposed upon contractors who supply special hardware and equipment. In general, evaluation and acceptance of these procured items are performed at the supplier's plant by field representatives, with the material shipped directly to the WIPP site.

1.3.1.3 Construction Procurement--Procurement of raw materials, finished materials, goods and services for construction of structures, systems or equipment important to safety is monitored by quality assurance. Monitoring includes:

- Review and evaluation of test and inspection data for conformance to specifications
- Verification that certifications of material have been obtained where required
- Comparison of such certifications with specifications requirements
- Evaluation of the quality control exercised by the construction contractor on his subcontractors

1.3.1.4 Construction--Quality Assurance monitors the construction phase to assure incorporation of specified construction features and performance of necessary tests and inspections as the work progresses. All certifications are reviewed for compliance with State and National Codes and Standards, and the use of qualified personnel to conduct such work is verified. The program includes a review of the inspector's log, which contains a complete record of all pertinent data.

1.3.1.5 Operation--Quality Assurance focuses upon adequate attention to such details as planning, safety, maintenance and security. The movements of men and materials are evaluated. The maintenance schedule is reviewed to assure that equipment and facilities are repaired or replaced before they become unsafe. Standby equipment and fail-safe devices are also inspected, tested, maintained, and replaced as required.

1.3.2 CLASSIFICATION CATEGORIES

All plant facilities, including safety-related structures, systems, and equipment that will handle radioactive material or directly affect the handling of waste, are assigned one of the following design classifications:

Category I: All structures, systems and equipment whose failure could cause release of excessive amounts of radioactivity; those structures, systems and equipment that are essential for the safe shutdown of waste-handling operations without endangering the public health and safety during or following a safe shutdown earthquake or design basis tornado; or those structures, systems and equipment, including alarms, that are essential for the safety of plant personnel in the event of a radiological accident.

Category II: Structures, systems and equipment designed to permit waste-handling operations to continue without endangering the public health and safety.

Category III: Structures, systems, and equipment whose failure does not result in release of excessive amounts of radioactivity, or is not essential to continued waste receipt and storage operations.

1.3.3 ASSIGNMENT OF CATEGORIES

Design classifications are assigned to each item in facilities handling radioactive material by considering:

a. The hazardous nature of the radioactive material to be handled, including the quantity available, physical and chemical characteristics, potential mobility under postulated accident conditions, and the biological effect of the ionizing radiation present.

b. The specific safety-related functions performed by the component being evaluated during postulated normal and abnormal conditions.

c. The consequences of failure in terms of radiation dose received by personnel at the site boundary and also by personnel within the plant.

Preliminary equipment and facility classifications are established in Table II.1-1. As the design progresses and source terms, equipment design requirements, and accident analysis become better established, these design classifications will be changed as necessary.

TABLE II.1-1

Preliminary Design Classifications

Item	Design Classification
Remote Handling Waste Facility	
Structures	
Receiving Area	II
Transfer Gallery	II
Cask Preparation/Decontamination	I
Cask Elevator Room	I
Hot Cell	I
Clean Cell	I
Mine Hoist Loading Area	I
Underground Transfer Cell	I
Permanent Brattices Between Mining/Storage Areas	I
Laboratory Areas	III
Components	
Waste Shipping Cask Crane	II
Cask Transfer Vehicle	II
Cask Elevator	I
Cask Transfer Vehicle Rails	II
Cask Seal Assembly	I
Hot Cell Bridge Crane	II
Canister Cleaning Station Doors	II
Canister Storage Pits	II
Overpack Welding Equipment	III
Canister Leak Test Equipment	III
Clean Cell Bridge Crane	II
Crane Rails	II
Cask Cooldown Station Supports	II
Mine Shaft Cage Carousel	II
Mine Hoist	II
Railroad Rails	II

TABLE II.1-1 (contd)

Item	Design Classification
Systems	
Receiving Area HVAC	III
HVAC, Other Areas	I
Normal Lighting	III
Emergency Lighting	I
Fire Suppression System, Receiving Area, Transfer Gallery	II
Fire Suppression Systems, Other Surface Areas	I
Service Water System	II
Recycle Water System	III
Radioactive Waste Systems	I
Emergency Power Distribution System	I
Normal Power Distribution System	II
Floor Drains, Hot Cell	II
Service Air System	II
Waste Shipping Cask Cooling System	II
Canister Cleaning System	II
Instrumentation System	
Area Radiation Monitoring	I
Barrier Air Flow Monitoring	II
Security (Safety-Related)	I
Security (Nonsafety-Related)	III
Emergency Communication System	I
Prefilter Water Spray System	I
TRU Waste Facility	
Structures	
Receiving Area	I
Air Locks	II
Air Lock Doors	II
Missile Doors	I

TABLE II.1-1 (contd)

Item	Design Classification
TRU Waste Facility	
Structures (contd)	
Inventory/Preparation Area	I
Overpack and Repair	I
Shaft Loading Stations	I
Laboratory Area	III
Permanent Brattices Between Mining/ Storage Areas	I
Components	
Receiving Area Cranes and Rails	II
Overpack and Repair Area Crane	II
Dock Levelers/Hydraulic Lift	III
Forklift Battery Recharging Equipment	III
Overpack and Repair Area Hoist	III
Mechanical Equipment/HEPA Filter Floor Hoist	III
Shaft Loading Station Equipment	II
Railroad Rails	II
Systems	
HVAC	I
Normal Lighting	III
Emergency Lighting	I
Fire Suppression System, Surface Area	I
Service Water System	II
Recycle Water System	III
Liquid Radioactive Waste System	I
Emergency Power Distribution System	I
Normal Power Distribution System	II
Floor Drains	II
Service Air System	III
Instrumentation Systems	
Area Radiation Monitoring	I
Barrier Air Flow Monitoring	II
Security (Safety Related)	I
Security (Nonsafety-Related)	III

TABLE II.1-1 (contd)

Item	Design Classification
Emergency Communication System	I
Prefilter Water Spray System	I
Emergency Power Building	
Structure	I
Components	
Diesel Generators	I
Diesel Fuel Day Tanks	I
Diesel Fuel Storage Tanks	I
Starting Air Supply Skids	I
Radiators	I
Monorail Hoist	II
Systems	
Instrumentation	
Diesel Generator Supervisory/Control Area	I
Security	I
Communications	I
Emergency Lighting	I
Normal Lighting	III
Fire Suppression System	I
Cooling Water System	I
Service Water System	III
Service Air System	III
Emergency Power Distribution System	I
Normal Power Distribution System	II
Floor Drains	III
UPS System	I
HVAC-Tornado Missile Barrier Components	I
HVAC-Other	III
Suspect Waste/Laundry Building	
Structure	I

TABLE II.1-1 (contd)

Item	Design Classification
Components	
Laundry Equipment	III
Spent Resin Storage Tank	II
Systems	
Liquid Radioactive Waste System Inside Building	II
Liquid Radioactive Waste System-Piping-Outside Category I Structure	I
Instrumentation	
Building Radiation Monitoring	I
Security (Safety-Related)	I
Emergency Communications	I
Emergency Lighting	I
Normal Lighting	III
Fire Suppression System	I
Service Water System	III
Service Air System	III
Power Distribution System	II
Floor Drains	II
HVAC-Tornado Missile Barrier Components	I
HVAC-Other	II
Prefilter Water Spray System	I
Administration Facility - Operations Control Structure	
Structure	I
Components	
Computer	I
Mechanical Repair Components	III
Laboratory	III

TABLE II.1-1 (contd)

Item	Design Classification
Systems	
UPS	I
Emergency Communications	I
Fire Suppression System	I
Emergency Lighting	I
Normal Lighting	III
Normal Power Distribution System	III
Emergency Power Distribution System	I
HVAC - Computer-Related	I
HVAC - Other	II
Instrumentation	
Security (Safety-Related)	I
Category I System Control Panels	I
Other Control Panels	Same as equipment controlled
TRU/RH Hoisthouse	
Structure	I
Access Tunnels	I
Hoisting Equipment	I
Systems	
HVAC	II
Fire Suppression System	I
Emergency Lighting	I
Normal Lighting	III
Normal Power Distribution System	II
Emergency Power Distribution System	I
Instrumentation	
Security System (Safety-Related)	I
Service Air System	III
Service Water System	III
Other	Same as equipment controlled

TABLE II.1-1 (contd)

Item	Design Classification
Mine Storage Filter Building	
Structure	I
Components	
Filter Handling Equipment	III
Prefilter Washing Equipment	III
Emergency Power Distribution System	I
Normal Power Distribution System	II
Prefilter Water Spray System	I
Service Water System	III
Service Air System	III
Mine Storage Filter System	I
Emergency Communications	I
Normal Lighting	III
Emergency Lighting	I
Fire Suppression System	I
Liquid Radwaste System	I
Instrumentation	
HVAC	I
Security (Safety-Related)	I
Area Radiation Monitoring	I
Water Pump House	
Structure	I
Systems	
Fire Suppression System	I
HVAC	II
Normal Electrical Power	III
Emergency Electrical Power	I
Emergency Lighting	I
Normal Lighting	III
Emergency Communications	I
Domestic Water System	II
Miscellaneous	
Suspect Waste Pond	I
Emergency Hoist Power on Construction Vent	I
Gatehouse	III
Utility Power Line	II
Switchyard	II

1.4 DESIGN BASIS

1.4.1 SURFACE AND UNDERGROUND CHARACTERISTICS

The site selection criteria, the field investigations and site characteristics are detailed in the site selection report "Site Selection and Evaluation, Los Medaños, New Mexico: A Summary Report to Assist in Preparation of the DEIS For the Waste Isolation Pilot Plant," SAND77-0946, George B. Griswold, Division 5732, Sandia Laboratories, Albuquerque, NM, March 1977, and the draft environmental impact report, "Draft Environmental Impact Statement for Waste Isolation Pilot Plant, Eddy County, NM," SAND77-0650, Sandia Laboratories, Albuquerque, NM, April 1977.

1.4.1.1 Stratigraphic Column--The stratigraphic column, developed from a drill hole at the site (ERDA #9), is as follows:

Geologic Formation	Thickness (ft)
Surface Sand	22
Mescalero Caliche	5
Gatuna	27
Santa Rosa Sandstone	9
Dewey Lake Redbeds	487
Rustler	310
Salado	1976
Castile	Unknown*

*Data from nearby drill holes imply approximately 1750 ft.

The subsurface formations dip slightly to the southeast. All the potential potash zones are located within the upper portion of the Salado formation. The Cowden anhydrite bed, 9 ft thick, is located in the lower portion of the Salado formation.

1.4.1.2 Potential Aquifers--There are three potential aquifers above the site: two dolomite beds within the Rustler formation and the brecciated salt interface between the Rustler and Salado formations. The upper dolomite is known as the Magenta and the lower the Culebra. Existing data and hydrological tests show that all three zones are essentially dry and present few problems for shaft-sinking operations.

1.4.1.3 Mining Horizons--Two mining horizons have been selected for the initial facility design. The upper horizon lying between 2060 and 2090 ft is used for TRU contact waste; the lower horizon lying between 2620 and 2690 ft is used for remotely handled waste. Based on core analysis and borehole logs from ERDA No. 9, these horizons are relatively consistent.

1.4.2 ABOVEGROUND STRUCTURAL DESIGN BASIS

Load	Structural Design Basis
Conventional	Roof live loads and floor live loads are based on the requirements of the ANSI A58.1-1972 Code.
Wind	Wind loads are based on the requirements of the ANSI A58.1-1972 Code, with exposure C terrain classification, and the ERDA Guide for calculation of Design Wind Pressures. Category I Facilities See Design Basis Tornado Category II Facilities 1,000-yr mean recurrence level wind: 140 mph Category III Facilities Administration building (administration and security area): 100-yr mean Recurrence level wind: 101 mph Other structures: 50-yr mean Recurrence level wind: 91 mph
Earthquake	Structures, systems, and equipment in the Categories I and II facility design classifications are designed to withstand forces produced by the earthquake-induced free-field ground motions of intensities defined as follows: Category I Facilities Safe Shutdown Earthquake--the earthquake that would induce at the WIPP site a free-field vibratory ground motion having a maximum ground acceleration with a horizontal component and a vertical component of 0.10 g. Category II Facilities Operating Basis Earthquake--the earthquake that would induce at the WIPP site a free-field vibratory ground motion having a maximum ground acceleration with a horizontal component and a vertical component of 0.05 g.

Load (contd)	Structural Design Basis (contd)
	Category III Facilities
	Earthquake loads are established and applied to these facilities in accordance with the requirements of the Uniform Building Code (1076 Ed.).
Tornado	The generalized tornado frequency and intensity classifications established in WASH-1300 for nuclear power plant design are not necessarily applicable to the WIPP. To define accurately the most realistic and probable Design Basis Tornado, an independent analysis by an expert tornado consultant will be accomplished prior to Title I design. Tornado and tornado-induced missile characteristics will be established for the WIPP facility design. Until that analysis is made, the following conservative tornado characteristics and induced missiles are assumed:

Tornado Characteristics

a. Maximum wind speed = 300 mph. This represents the sum of the rotational speed component and the maximum translation speed component.

b. Rotational speed = 240 mph. This represents the vector sum of the radial and tangential speed components.

c. Translational speed:
Maximum = 60 mph
Minimum = 5 mph

d. Radius of maximum rotational speed = 150 ft

e. Pressure drop = 2.25 psi

f. Rate of pressure drop = 1.2 psi/s

Missiles

a. Structural shape = W14x34, 30 ft long, 1020 lbs, 120 ft/s horizontal velocity

b. Steel pipe = 6-in. diameter, Sch. 40, 21 ft long, 400 lbs, 138 ft/s horizontal velocity

Load (contd)	Structural Design Basis (contd)
	c. Wood utility pole = 14-in. diameter, 35 ft long, 1500 lbs, 157 ft/s horizontal velocity
	d. Automobile = 20 ft^2 frontal area, 4000 lbs, 171 ft/s horizontal velocity

Combination of Loads

Conventional	The individual loads representing the components of dead load, live load, wind load and earthquake loads are combined for design purposes according to the requirements of the ANSI A58.1-1972 Code.
Tornado	The loadings from the three individual tornado-generated effects are combined as summarized below for the design loads on those parts of the facility that are to withstand tornado effects.

Load Component Identification

W_t = total tornado load

W_w = tornado wind load

W_p = tornado differential pressure load

W_m = tornado missile load

Load Combinations

$W_t = W_w$

$W_t = W_p$

$W_t = W_m$

$W_t = W_w + 0.5\ W_p$

$W_t = W_w + W_m$

$W_t = W_w + 0.5\ W_p + W_m$

The tornado loadings are combined with the dead loads, other fixed loads and appropriate live loads in considering critical design load combinations.

1.4.3 UNDERGROUND STRUCTURAL DESIGN BASIS

The shafts, the open areas around the shaft and the main entry system on both mine levels are designed for a minimum life of 30 years. In the TRU storage area, a design life of 15 years was used. In the RH level storage areas, the drifts were designed to maintain at least 50 percent of their original height and width for 15 years.

1.4.3.1 Mine Stability--With the lack of in-situ data and incomplete laboratory data, a literature search was made to establish stability data. The published data indicate that with extraction ratios of less than 40 percent for the TRU level and less than 30 percent for the RH level, the mine should be stable for the design life.

1.4.3.2 Salt Creep--The creep law developed for the IMC Saskatchewan potash mines and reported by Coolbaugh was used as a basis for the creep calculations. It was assumed that the calculated creep would become steady-state after 1 year and remain constant thereafter.

1.4.3.3 Pillar Size--The tributary area load method was used to determine confined core pillar sizes; this method was developed and reported by Wilson in 1972. Wilson postulated that the triaxially confined strength of the rock would be the maximum stress that could be carried by the confined core of a pillar. The confinement for this core is the acting horizontal stress and is limited to the in-situ horizontal stress. It was assumed for the conceptual design analysis that hydrostatic stress conditions existed, and thus the in-situ horizontal stresses would be approximately equal to the overburden stress. To use the confined core method, it is necessary to establish the passive pressure coefficient, shear strength, the angle of internal friction, and the cohesion of the rock. The passive pressure coefficient dictates the peak vertical pressure that the pillar can sustain with the existing horizontal in-situ stress confinement. The shear strength determines the distance from the pillar's edge to the confined core. With insufficient test data from the study area, a detailed literature search established 30° for the angle of internal friction and 450 psi for the rock mass cohesion as the most realistic values available. Wherever there was doubt as to the value of a given parameter, a conservative approach was taken to ensure an adequate margin of safety and a stable facility.

1.5 NUCLEAR REGULATORY COMMISSION (NRC) LICENSING CONSIDERATIONS

1.5.1 APPLICABILITY OF EXISTING REGULATIONS

The charter for the WIPP is to store on a retrievable basis ERDA contact-handled TRU waste, ERDA remote-handled intermediate-level waste, and waste for high-level experiments. Although this charter does not require an NRC license, a requirement upon the design effort has been to produce a conceptual design that complies with NRC licensing regulations.

Existing licensing regulations do not apply directly to a waste storage or disposal facility; however, they were reviewed for an understanding of philosophy and to extract pertinent portions that might be incorporated into the design criteria for the WIPP (see Addendum K). This review indicated that the NRC has relied on a defense-in-depth concept in issuing licenses to nuclear facilities, a concept built on three main principles:

a. Assurance that the highest quality components and materials necessary for plant safety are used in the design.

b. Redundant components necessary for safety are included in the design.

c. The plant's ability to respond to accidents is determined, and the effects on the health and safety of the public are assessed. This conceptual design implements the NRC philosophy in order not to preclude future licensing.

1.5.2 AREAS OF CONCERN FOR A REPOSITORY DESIGN

Accident Analysis. The types of accidents analyzed for the WIPP differ from those analyzed for other facilities. The loss of coolant, and steam-line-break accidents, of concern in nuclear power plants, are replaced by more conventional fire and material-handling accidents in the WIPP. Though the radioactive source terms are different, the problem of dispersion of radioactive material to the environment must still be considered. A preliminary accident analysis is included as Addendum G.

Plant Security. NRC guidelines and requirements for plant security have been incorporated into the Code of Federal Regulations for other types of nuclear facilities. The requirements for the WIPP should be less since there is no special nuclear material, nor are there any high-energy systems to cause major problems.

Instrumentation and Standby Power. Facility instrumentation for operational monitoring and control is tied to the standby power as are the mine hoists, ventilation and other safety equipment.

Barriers. Multiple barriers to prevent release of radioactive material to unrestricted areas are common to all nuclear facilities. The barriers at the WIPP include the form of the waste material, waste containers, facility buildings, and ventilation system HEPA filters. The intent of regulations designed to protect release barriers under comparable conditions at other nuclear facilities is incorporated into the design of the WIPP.

1.6 ENERGY ANALYSIS

A study and evaluation of the total energy balance for the Waste Isolation Pilot Plant (WIPP) was undertaken. Many energy conservation considerations, several electrical energy sources, and many HVAC schemes were considered and evaluated; however, much study is still required for the heating and cooling systems at Title I design. The following comments are summary only. For details, refer to Addenda D and F.

1.6.1 CONSERVATION

HVAC. The following were HVAC energy conservation considerations:

Light systems. Light fixtures that circulate return air through the fixture, and water-cooled light fixtures. Low-pressure sodium light fixtures for outdoor security lighting.

Two-stage systems for large evaporative cooler installations.

Time-clock control for large air compressors that supply systems not needed during unoccupied hours.

Water-to-air heat pump applications where large internal load areas can return needed heating to other spaces in the building.

Use of a cooling tower/fluid cooler rather than refrigeration to remove process heat.

Use of the storage tanks in the summer for storage of cooled water from a fluid cooler in a cooling tower that is run during the night. This cool water can be used in the normal building chilled water system during periods of moderate load.

Installation of an evaporative section in the refrigerative air conditioning system to carry the building cooling load during periods of moderate loading.

Use of a "thermocycle" option or other similar heat-transfer system on the chiller to air condition during the winter without running the prime mover in the refrigeration system.

Use of heat-recovery systems to bring heat from high internal loads in interior zones to exterior zones.

Solar heating for all buildings.

A central chilled water plant.

Multiple fans with either selective air volume control dampers or variable speed fans, all controlled by head pressure sensing, for refrigeration systems.

Avoidance of use of glycol in chilled water circuits wherever possible.

Heat recovery systems for HVAC systems with exhaust over 4000 cfm. Life-cycle cost studies were performed to justify their consideration.

Combining exhaust outlets into a central system to enhance use of heat recovery systems wherever possible.

Architectural. The following items represent the major architectural energy conservation methods that have been investigated and incorporated as permitted by construction.

a. Minimum windows are used; however, where used, they are fixed with reflective insulating glass.

b. Insulation is used as required to achieve the following ERDA 6301 U-factors:

		Office Areas	Work Areas	Warehouse
(1)	Roofs	0.07	0.08	0.10
(2)	Exterior walls	0.084	0.098	0.126

c. Light-colored exterior surfaces are used to reduce the solar heat gain.

d. Exterior openings are adequately weather stripped.

e. Vestibules are provided at all normal building entrances, where practical, to serve as airlocks and maintain negative building pressures.

1.6.2 ALTERNATIVE ENERGY SOURCES (ELECTRICAL)

The operation of the WIPP requires large quantities of electrical energy, primarily for mining-related tasks. The five large 1500-hp-ea, electric-powered mining machines, the 3000-total-hp hoists, the 1150-total-hp mine fans are the most significant. With a total site electric demand of approximately 20 MW, and with an emergency standby requirement of ~5 MW, on-site power generation appeared possible; and a subsequent study was undertaken (see Addendum D). The study results recommend purchasing power from the local utility.

1.6.3 HVAC

The four major buildings of the WIPP were analyzed by the Trane Co.'s TRACE HVAC load analysis program using the parameters described in Addendum F, HVAC Energy Study. The results favor all-electric heat pumps with varying degrees of solar, evaporative cooling, and heat recovery.

Since the TRACE program does not consider solar heating or evaporative cooling (these were supplementary calculations), a more comprehensive HVAC study will be performed at Title I design with the CALERDA program.

2. WASTE-HANDLING FACILITIES

2.1 TRU WASTE FACILITY

2.1.1 SURFACE FACILITY

The surface facility (see Drawings 94541) provides facilities for personnel and equipment required to transfer TRU waste from incoming shipping containers to the TRU shaft for transfer to storage in the TRU storage horizon of the mine. Wide-open spaces are characteristic of the design; this allows acceptance of a wide variety of packages and shipping configurations. This facility is a tornado-missile-hardened structure constructed of poured-in-place concrete, with all fenestrations protected to prevent the penetration of tornado-borne missiles. The building is divided into the following general areas:

Area	Function
Material Entries	Airlocks are provided at points of entry for both railcars and trucks. The airlocks are designed to control the movement of outside air into the unloading/loading area where possible contamination may be present. Interlocking rollup doors are located at the ends of each airlock. A special tornado door located near the unloading/loading area door is provided to abort tornado-borne missiles. The door is normally open and will be closed only during a tornado alert.
Unloading/Loading	Facilities to unload waste from incoming transport vehicles and load empty containers on outgoing vehicles. It contains sufficient space along its length to accommodate three railcars. Space is also provided for two tractors and trailers at one end of the dock. Shipping container unloading stations are provided on the dock. The unloading/loading area is 4 ft above the train rails. Two dock levelers and a hydraulic lift (25-ton capacity) are provided at the

Area	Function
	truck area. (The hydraulic lift is used to lift forklifts from the ground level to the 4-ft level.) Two 25-ton cranes are provided in this area to remove the shipping containers from their transport vehicles.
Inventory and Preparation	Space for inspection, inventory control, loading and temporary storage of TRU waste containers. Space is provided to test the interior of the shipping containers for airborne contamination and to open the shipping containers, remove the waste packages by forklifts, and transfer them to an empty pallet. A hold area is provided to accommodate a 5-working-day shipment of waste packages in the event of a shaft malfunction or scheduled preventive maintenance. This area also provides access to the overpack and minor repair areas. A forklift battery recharging area is also provided.
Cage Loading Rooms	Two rooms, one on each side of the TRU shaft, provide access to load wastes onto the shaft cage and serve as airlocks between the inventory and preparation area and the TRU shaft. Each room has two doors that are interlocked to minimize air movement from the inventory and preparation area to the shaft.
Minor Repair Rooms	Space to repair waste container metal surfaces by wire brushing or sandblasting, spray painting, and drying or to refinish cracked or broken fiberglass surfaces of RF boxes. The drum repair room serves as an airlock between the overpack and inventory/preparation rooms.

Area	Function
Overpack and Repair Room	Accommodates a supply of overpack containers, and work space for use when receiving contaminated TRU waste shipping containers. A 25-ton crane and a 6-ton hoist are provided in this area. Airlocks separate the overpack and repair room from adjacent areas. A one-man office is provided for communications and records.
Laboratory	To analyze radioactive samples and perform waste related analysis; separated from adjacent areas by an airlock. A one-man office is provided for communications and records.
Toilets, Locker Rooms, Shower Areas, and Health-Physics Check	The men's toilet, locker room and shower areas provide the required toilet facilities and personal lockers for 40 men. The health-physics check area contains personnel monitors and a radiological protective clothing disposal bin. Direct access to the shower room or to the locker room is provided. The women's toilet, locker room, shower, and health-physics check area provides the required toilet facilities and personal locker space for 14 women.
Other Areas	The office area provides space for supervisory and administrative personnel, a conference room, and an anti-C clothing issue room. Stairway access to the mezzanine is from this area. The corridor passing from the office area to the health-physics check area has a loop badge and radiation portal installed at the health-physics end to prevent unauthorized passage of contaminated personnel into the office area. The mezzanine provides space for two offices and for mechanical equipment serving the areas below.

Area	Function
Mechanical Equipment/ HEPA Filter Room	Space for the equipment required to pre-condition, control, and final-filter all ventilation air for the TRU building. Prefilter washing and storage space is also provided. The room contains a 5-ton monorail and an access hatch to install and remove equipment. Ladders and platforms are provided for access to the controls of the unloading/loading area 25-ton crane. This area also provides access to a ladder in the shaft that leads to the upper sheave room.
Upper Sheave Room/ Head Frame	The upper hoist sheave and sheave supports are located in this area and function as the TRU hoist head frame.
Lower Sheave Room	The lower hoist sheave and hoist-house access tunnel are located here.

2.1.1.1 Architectural

Functional Space Requirements. Space requirements are in accordance with the following:

Room Description	Area (sq ft)	Minimum Overhead Clearance (ft)
Airlocks	7,727	20
Unloading/Loading Area	6,861	51/47
Inventory and Preparation Area	36,000	24
Minor Repair Rooms	528	24
Overpack and Repair Room	3,480	47/24
Laboratory	1,152	10
Men's Toilet, Locker Room, Shower, Health-Physics Area	1,482	8
Hoist Loading Area	1,320	24
Women's Toilet, Locker Room, Shower, Health-Physics Area	1,450	8

Room Description	Area (sq ft)	Minimum Overhead Clearance (ft)
Corridor	1,195	10
Office Area	1,285	10
Mezzanine	5,412	24/10
Mechanical Equipment/ HEPA Filter Floor	36,070	12
Sheave Room	1,000	28

Building Materials. A summary of building materials is contained in Section 4.14.

2.1.1.2 Structural--The building is designed for the Category I classification. The structural framing is typically a poured-in-place reinforced concrete system. The roof, as well as the mezzanine and mechanical equipment floors, are beam and slab systems supported on concrete columns and interior and exterior concrete-bearing walls. The ground-level floor is a reinforced concrete slab on grade. Foundations are individual column and continuous wall spread footings. Combined mat-type footings bearing directly on grade are required in some areas. The building includes a hoist system upper sheave room for support and access to the upper sheave located directly above the mine shaft.

2.1.1.3 Mechanical

Domestic Water System. The estimated cold-water demand for this facility is ~110 gpm. A connection to the domestic water main is provided as shown on Drawing 94534-C1. Domestic hot water for the facility is provided by solar collectors in conjunction with the building heating system.

Soil, Waste and Vent System. A standard soil, waste and vent system serves the toilet room, janitor's closet, and is used for other normal services.

Compressed Air. Compressed air is piped to work stations.

Special Systems. The TRU waste facility houses two special systems requiring interior piping. These systems are the liquid waste collection tank and drains (see Section 4.11.1) and floor drains in waste-handling areas. The system is designed to carry radioactive liquids and to meet seismic criteria. The drains carry the liquid wastes to a 20,000-gal holding tank beneath the floor of the mechanical equipment room. Liquid is pumped from this tank to the Suspect Waste/ Laundry building.

HVAC Systems. Table II. 2-1-1-1 contains a summary description of the HVAC system in this building.

2.1.1.4 Electrical--The TRU Waste facility electrical system is described in Section 4.2 and Drawings 94541-E1 through E3. Facility electrical loads are described in Table II.4-2-1-1 and Addendum E. As in other WIPP facilities that handle wastes, the TRU electrical loads are classified as both normal and vital. The breakdown of the loads is included in Table II.4-2-1-1.

2.1.1.5 Material Handling Equipment--The following tables describe the material handling equipment to be used in the TRU Waste surface facility. Table II. 2-1-1-2 describes the number, type and use of the equipment items. Table II. 2-1-1-3 describes specific equipment items.

2.1.2 SHAFT AND SHAFT CONVEYANCES

The TRU shaft is used to move TRU waste from the surface to the storage level. The design of the shaft and shaft conveyances was dictated by the size, configurations and quantities of TRU waste containers to be handled at the WIPP. A time-and-motion analysis confirmed that the system would handle the design quantities (see Addendum A).

2.1.2.1 Shaft--The 17.5-ft-diameter, 2180-ft-deep circular shaft (see Drawing 94569-A1) is lined with concrete from the surface to and including the first 15 ft of the Salado formation. A water ring is provided at this level, and the shaft is unlined the rest of its length. Seepage into the shaft through the concrete lining is collected by the water ring, and piped to a small sump 13 ft below the floor of the TRU level. It is then transferred to a tank that is hoisted to the surface and emptied into the liquid radwaste treatment system.

Headframe. The headframe is an integral part of the TRU surface facility and is shown on Drawings 94541.

Shaft Station. An opening 16.5 ft high by 40 ft wide (see Drawing 94569-A3) allows movement of both personnel and equipment alongside the shaft in the station area. Cage unloading time is minimized by a capability to unload in either direction along the station axis. Sufficient space is available to store four pallets of waste containers.

TABLE II.2-1-1-1

HVAC Systems

The following table describes the TRU Waste facility HVAC system. General characteristics of the radwaste handling facilities HVAC systems are described in Section 4.1.2. Bases for selecting specific system energy conservation components are discussed in Addendum F, HVAC Energy Study (see 94541-A1 and M1).

Area	Design Objective	Ventilation Concept	Heat Gain and Loss Assumptions	Equipment Selection
Material Entries	Maintain pressure differential between load/unload area and atmosphere during vehicle movement in/out. Control diesel exhaust fumes.	Rough-filtered air enters airlocks at roof level, exhausts at ground level by fans discharging to atmosphere. Airflow is 6 air changes/hr to control diesel exhaust fumes.	None	Supply filters: Washable, metal-mesh filters and roof-level inlet vents. Exhaust fans: Backward-curve, nonoverloading.
Loading/ Unloading	Temperature control, diesel-fume control; maintenance of a pressure differential.	Inlet air is rough-filtered, heated or cooled as required and introduced at a high elevation. Inlets have pressure-control dampering to maintain area below atmospheric pressure.	Lighting: 4 W/ft^2 (avg) Waste drums: 320 @ 10 W dissipation Hoists: 2 25-ton @ 40 hp, 50% usage factor People: 10 moderately active @ 300 Btu/hr sensible Donkey engines: Discounted	Supply air handling units: Washable metal-mesh prefilters, roughing filters, heating and cooling coils, recovered energy coils, evap. cooling sprays, supply fans. Exhaust air handling units: Metal-mesh spark arrestors w/ water sprays and mist eliminators, 2 stages of roughing filters,

TABLE II.2-1-1-1 (Contd)

Area	Design Objective	Ventilation Concept	Heat Gain and Loss Assumptions	Equipment Selection
		Air is exhausted at floor level through HEPA filter banks to central exhaust stack. Drained grated floor trenches serve as the fire protection sprinkler water capture system and are connected to the suspect waste system. Air inlets/outlets have tight shutoff dampers for emergencies. Airflow requirements are based on 4 air-changes/hr.		3 stages of HEPA filters, airfoil-type fans.
Inventory/ Preparation	Temperature control, entrapment of airborne contaminants generated in the inspection/ palletizing operations; maintenance of a pressure differential between this and adjoining spaces.	Inlet air is rough-filtered, heated or cooled as required and introduced at a high elevation. Inlets have pressure-control dampering to maintain area below atmospheric pressure, and above the adjacent areas (except offices).	Lighting: $4\ W/ft^2$ (avg) Waste drums: 1620 @ 10 W dissipation Forklifts: 2 @ 20 hp, 75% usage factor People: 25 moderately active @ 300 Btu/hr sensible	Supply air handling units: Washable metal-mesh prefilters, roughing filters, heating coils, cooling coils, recovered energy coils, evap. cooling sprays, and supply fans. Exhaust air handling units: Metal-mesh spark arrestors w/water

TABLE II.2-1-1-1 (Contd)

Area	Design Objective	Ventilation Concept	Heat Gain and Loss Assumptions	Equipment Selection
		Air exhausts through floor grates in the receiving/inspection palletizing areas, and discharges through the HEPA filter banks to the central stack. Air inlets/outlets have tight shutoff dampers for emergencies. Airflow requirements are based on 10 air changes/hr.		sprays and mist eliminators, 2 stages of roughing filters, 3 stages of HEPA filters, and airfoil-type fans.
Overpack and Repair Rooms	Temperature control, entrapment of airborne contaminants from overpack/repair operations, and maintenance of a pressure differential between area and adjoining spaces.	Inlet air is rough-filtered, heated or cooled as required and introduced at a high elevation. Inlets have pressure-control dampering to maintain pressure at a lower level than all adjacent areas. Air exhausts through floor grates, and discharges through a HEPA filter bank to the central stack. Air inlets/outlets have tight shutoff dampers for emergencies. Airflow requirements are	Lighting: 4 W/ft^2 (avg) Waste drums: 60 @ 10 W dissipation Hoist: 25-ton, 40 hp, 50% usage factor People: 5 moderately active @ 300 Btu/hr sensible	Supply air handling units: Washable metal mesh prefilters, roughing filters, heating coils, cooling coils, recovered energy coils, evap. cooling sprays, and supply fans. Exhaust air handling units: Metal mesh spark arrestors w/water sprays and mist eliminators, 2 stages of roughing filters, 3 stages of HEPA filters, and airfoil-type fans.

TABLE II.2-1-1-1 (Contd)

Area	Design Objective	Ventilation Concept	Heat Gain and Loss Assumptions	Equipment Selection
		based on 12 air changes/hr.		
Laboratory	Shares common supply/exhaust equipment with overpack and repair rooms. Air change requirements and pressure are similar.			
Minor Repair	To entrap air-borne contaminants generated by repair and very nominal paint-spraying operations. To maintain a pressure differential between inventory/preparation and overpack/repair areas.	Inlet air comes from inventory/preparation air-supply system and inlets have pressure control dampers to maintain air pressure at an intermediate level between inventory/preparation and overpack/repair. Air exhausts through rough filtered hoods at sources of contamination and discharges through a HEPA filter bank to the central exhaust stack. Air inlets/outlets have tight shutoff dampers for emergencies. Airflow requirements are based on 12 air changes/hr.	None	Exhaust air system has exhaust hoods w/ disposable filters. The rest of the exhaust system equipment is similar to that described for the unloading/loading area.

TABLE II.2-1-1-1 (Contd)

Area	Design Objective	Ventilation Concept	Heat Gain and Loss Assumptions	Equipment Selection
Battery Charging	To entrap hydrogen fumes generated by the forklift battery charging operation.	Air exhausts through explosion-proof hoods at ceiling level and discharges through a HEPA filter bank to the central exhaust stack. Hoods have tight shutoff dampers for emergencies. Hood makeup air is drawn from adjacent areas.	None	Exhaust: Hoods w/ explosion-proof lighting and electrical interlocks between battery-charging equipment and fans so that failure of fans renders the battery-charging equipment inoperative. Exhaust air handling units: Metal mesh spark arrestors w/water sprays and eliminators, 1 stage of roughing filters, 3 stages of HEPA filters, and explosion-proof fans w/nonsparking wheels.
Cage Loading Rooms	To maintain a pressure differential between the mine shaft and the inventory/preparation area, and to prevent contaminant flow from inventory/preparation area to shaft.	Inlet air comes from the inventory/preparation system. Inlets have pressure-control dampering to maintain area at below atmospheric pressure and above the pressure of adjacent areas. Air exhausts near floor	None	Supply air handling units: Washable metal mesh prefilters, roughing filters, heating coils, cooling coils, recovered energy coils, evap. cooling sprays, and supply fans. Exhaust air handling units:

TABLE II.2-1-1-1 (Contd)

Area	Design Objective	Ventilation Concept	Heat Gain and Loss Assumptions	Equipment Selection
		and discharges through a HEPA filter bank to the central exhaust stack. Air inlets/outlets have tight shutoff dampers for emergencies. Airflow requirements are based on 12 air changes/hr.		Metal mesh spark arrestors w/water sprays and mist eliminators, 2 stages of roughing filters, 3 stages of HEPA filters, and airfoil-type fans.
Shaft/Hoist	To maintain upcast airflow in the mine shaft and airflow in the cable tunnels from the hoisthouse to the hoist head-frame enclosure.	Inlet air for the mine shaft is drawn from the mine. Air is exhausted from the head-frame enclosure and discharges through a HEPA filter bank to the central exhaust stack. Inlet air to the head-frame enclosure also comes from the hoisthouse via the cable tunnels. Static pressures and airflows are controlled by inlet dampers on the exhaust fans and at the hoisthouse, with the head frame enclosure maintained at a sufficient negative pressure to ensure the required upcast flow through the shaft. Air inlets/outlets have tight shutoff dampers for emergencies.	None	Exhaust: Same as for the unloading/loading area except that exhaust fans are equipped w/inlet vane dampers.

TABLE II. 2-1-1-2

TRU Material Handling Equipment List

Item No.	Quantity	Item	Duty
1	2	Forklift	Lift M3 lids, move empty drums and boxes
2	1	Forklift	Unload single drums in overpack area
3	5	Forklift	Unload 55Ds (3/lift) from Super Tigers (STs) and Cargo Containers (CCs), unload 55Ds (1 or 4 per lift) from M3s. move ramps
4	2	Forklift	Move Rocky Flats boxes (RFs), M3s, empty pallets, and large ramps
5	1	Forklift	Move loaded pallets
6	1	Dolly	Move STs, CCs, and loaded pallets into overpack area
7	80	Pallets	Transport drums, RFs and M3s into underground storage
8	7	Ramps	Provide access to CCs
9	9	Ramps	Provide access to STs
10	7	Ramps	Provide end access to pallets
11	12	Ramps	Provide side access to pallets
12	2	Spreaders	Lift 4 M3s
13	2	Spreaders	Lift STs and CCs
14	2	Spreaders	Lift ATMX lids
15	2	Forklift Attachments	Lift M3
16	2	Forklift Attachments	Lift M3 lids
17	5	Forklift Attachments	Remove drums from M3
18	4	Forklift Attachments	Remove drums from CC and ST
19	2	Forklift Attachments	Remove contaminated drums from ST and CC

TABLE II. 2-1-1-3

TRU Material Handling Equipment Descriptions

Items 1, 2 — 1500-lb Forklift — Quantity 3

Battery drive, maximum height with mast lowered not to exceed 76 in., lift height at least 108 in.

Item 3 — 5000-lb Forklift — Quantity 5

Battery drive, maximum height with mast lowered not to exceed 76 in., lift height at least 108 in.

Item 4 — 15,000-lb Forklift — Quantity 2

Battery drive, lift height at least 120 in.

Item 5 — 40,000-lb Forklift — Quantity 1

Diesel drive, lift height at least 80 in.

Item 6 — 8' x 20' Dolly — Quantity 1

Fabricated steel platform mounted on express rollers or equivalent and equipped with chain or winch two-way drive to travel 125 ft. Capacity to move up to 25 tons. Weight of dolly approximately 3000 lb.

Item 7 — 8.5' x 12.5' Pallets — Quantity 80

Steel pallets fabricated from channel, beams and plate to hold 24 55-gal drums weighing up to 1000 lb each and permit lifting loaded pallet from the side by a forklift. Must also accept loaded forklift weighing up to 30,000 lb driven on to the pallet. Pallet weight approximately 2000 lb.

Items 8-11 — Ramps — Quantity 35

Fabricated steel ramps with dimensions and approximate weights as follows:

Quantity	Dimensions	Weight (lb)
7	4' x 6' x 6.5"	400
9	5' x 6' x 11"	500
7	6' x 8' x 6"	1000
12	5' x 10' x 6"	1400

TABLE II. 2-1-1-3 (contd)

<u>Item 12</u> <u>Spreaders</u> <u>Quantity 2</u>

A 4' x 5' steel rectangle fabricated from heavy plate and beams. A special design, 5-ft-long lifting bar is suspended by a chain from each corner to engage the lifting eyes of an M3 container weighing up to 10,000 lb each. The spreader weighs about 1500 lb.

<u>Item 13</u> <u>Spreaders</u> <u>Quantity 2</u>

An 8' x 20' rectangular steel framework fabricated from heavy structural members with special lugs at appropriate places for engaging the lifting eyes in the top corners of STs and CCs weighing up to about 47,000 lb. The spreader weighs about 1800 lb.

<u>Item 14</u> <u>Spreaders</u> <u>Quantity 2</u>

A 10' x 17' steel rectangle fabricated from structural members with hooks at the corners to engage lifting eyes in the ATMX lids weighing about 2500 lb each. The spreader weighs about 700 lb.

<u>Item 15</u> <u>Forklift Attachment</u> <u>Quantity 2</u>

A device to attach to the forks of a forklift. A chain or wire rope suspends a heavy beam about 5 ft long and suitable for lifting a 10,000-lb M3.

<u>Item 16</u> <u>Forklift Attachment</u> <u>Quantity 2</u>

A mechanical or pneumatic lifting device suspended from forklift forks to grip and transport, one at a time, M3 lids weighing about 100 lb each.

<u>Item 17</u> <u>Forklift Attachment</u> <u>Quantity 5</u>

A grappling device based on the principle of the Lift-O-Matic, to grip the rim of a 55-gal drum weighing about 1000 lb. The device, attached to the forks of a forklift, extends downward about 5 ft and requires 360-degree rotation ability at the plane of contact with the forks.

<u>Item 18</u> <u>Forklift Attachment</u> <u>Quantity 4</u>

An attachment on the front of a forklift for lifting and transporting simultaneously three 55-gal drums weighing 1000 lb each. This device must project and retract so that drums can be lifted when the load center is 36 inches in from the forkface. The outboard arms of the device have extension/retraction ability up to 7.5 ft.

<u>Item 19</u> <u>Forklift Attachment</u> <u>Quantity 2</u>

This attachment is essentially the center portion of Item 18 for lifting a single drum weighing about 1000 lb. It must have the extension/retraction capability but does not have the movable side arms. One device is sized for 55-gal drums, the other for 83-gal drums.

2.1.2.2 Shaft Conveyance--The shaft cage (see Drawings 94569-M1 through -M3) has a capacity for a 9 x 13 ft loaded pallet weighing 12.5 tons. The pallet-loading arrangements shown on Drawing 94569-A2 and rollers in the floor of the cage, shaft station and collar station minimize cage loading and unloading time and maximize utilization of space. Interlocks on the cage doors prevent cage movement when they are open and prevent their being opened during cage travel. A similar system on the shaft access doors prevents opening unless the cage is at the station. Manual overrides are provided. Rigid cage guides are used, since access for maintenance and adjustment is not a problem.

Hoist. The hoist system has the following features:

Hoist type	Single drum
Net hoist capacity (tons)	12.5
Hoist rope diameter (in.)	2
Hoist rope safety factor	5
Drum diameter (in.)	160
Drum face width (in.)	155
Motor horsepower	800

This system was selected after consideration of the loads and rates of movement required to meet the design throughput.

2.1.3 TRU UNDERGROUND LEVEL

The TRU level development (see Drawings 94570-A1 through -A3) encompasses an area of ~400 acres, of which about 150 are used for storage. It is west of the shaft area and as near the 1000-ft-radius shaft pillars as possible. The main entries run east-west, with the panel entries perpendicular to the main entries, or north-south. The rooms are then driven perpendicular to the panel entries. This arrangement was used to obtain square- and rectangular-shaped pillars for maximum stability. The TRU level dips slightly to the east (see Drawing 94570-A4).

Except for the minor amount of footage mined with conventional methods by the shaft crews, all openings on the TRU level are driven with continuous mining machines that cut an ovaloidal opening 10 ft high by ~18 ft wide in a single pass. All entries on the level are driven two passes wide by one pass high, which results in ovaloidal shaped openings 10 ft high by ~31.5 ft wide with an available roadway width of 27 ft. The storage rooms are three passes wide by two passes high and are 16.5 ft high by 45 ft wide, with a roadway width of 40.5 ft.

Four major conditions dictated the design of the underground layout:

a. that the storage and construction operations be separated from each other,

b. that the ventilation airstreams for storage areas be separated from those for the construction operations,

c. that a 1000-ft-radius shaft pillar be provided around each of the shafts, and

d. the quantities of TRU waste to be stored.

The resulting layout meets these conditions in the following manner: the two northernmost main entries are used for the waste storage operations and the two southernmost for construction. The outer two main entries are used for travelways and fresh-air intakes, while the two inner entries are used to route the exhaust airstreams from the working areas to the exhaust ventilation shafts. The salt conveyor system is installed in the construction exhaust entryway. The primary ventilation flow streams under maximum conditions and the routing for the salt-conveying system at its maximum extent are shown on Drawings 94570-A5 and -A6.

The waste receival rates dictated the storage sequence and mining plan included in Drawings 94570-A8 and -A9. Both operations progress on an advancing basis from the shaft area, constructing and filling the northern panels and then retreating back to the shaft area while mining and filling the southern panels. However, rather than retreating out of a panel as the storage does, the mining progresses on an advancing basis within a panel. Individual storage rooms within all the panels are constructed in a westerly direction, an arrangement dictated by the fact that the westernmost entry for each panel is used for ventilation exhaust.

Electrical Systems. The underground construction is highly mechanized; and heavy electrical demands are produced by the mining machines and conveyors, with lesser amounts by lighting, communications, alarms and shop equipment. The main power lines are installed in the man and material shaft and the standby lines in the construction ventilation shaft. If the main lines should become unavailable for use, the standby line can be used as a supply source for selected systems underground. A complete description of the electrical systems is included in Section 4.2 and Drawings 94570-E1 through -E4.

2.2 TRU WASTE HANDLING, EMPLACEMENT AND RETRIEVAL

(See TRU Waste Handling Schematic Fig. II. 2-2-1)

2.2.1 SURFACE FACILITY AND SHAFT

The TRU waste package and shipping configurations are defined in Section II. 1. 1 and summarized in Table II. 2-2-1-1. Figure II. 2-2-1-1 shows a normal flow pattern, and Drawing 94541-Al identifies all handling areas within the TRU surface facility. Table II. 2-2-1-2 provides the pallet loading configurations for all the TRU waste packages.

2.2.1.1 Normal Flow--All TRU waste shipments enter the building through the rail and truck airlocks. The two bridge cranes in the unloading/loading area are used to remove lids from ATMX cars and unload the shipping containers and waste packages from rail cars and truck trailers. All containers and packages are placed in areas outlined on the dock to assure proper clearances for forklift movements. The following operations occur after placement on the dock.

> The interior atmosphere in each shipping container is sampled before opening for the presence of airborne contamination.
>
> The shipping container is opened and a surface swipe performed on the waste packages on a sampling basis.
>
> The waste packages are transferred by forklift from the shipping container or dock to a pallet located in the pallet load area. Each waste package is entered into the inventory control system, checked against the shipping manifest, and identified with its pallet serial number.
>
> Fully loaded pallets are moved by a forklift to the hoist-loading area and into the cage load room.
>
> The loaded pallet is rolled onto the hoist cage floor thereby pushing any empty pallets into the cage unload room.
>
> Once the hoist cage door is closed, the loaded pallet is lowered through the shaft to the underground receiving station.

Should the above cycle be interrupted, the hold area will provide space for the palletized storage of 5 days' receipt of waste packages. This area is also used to store the inventory of empty pallets.

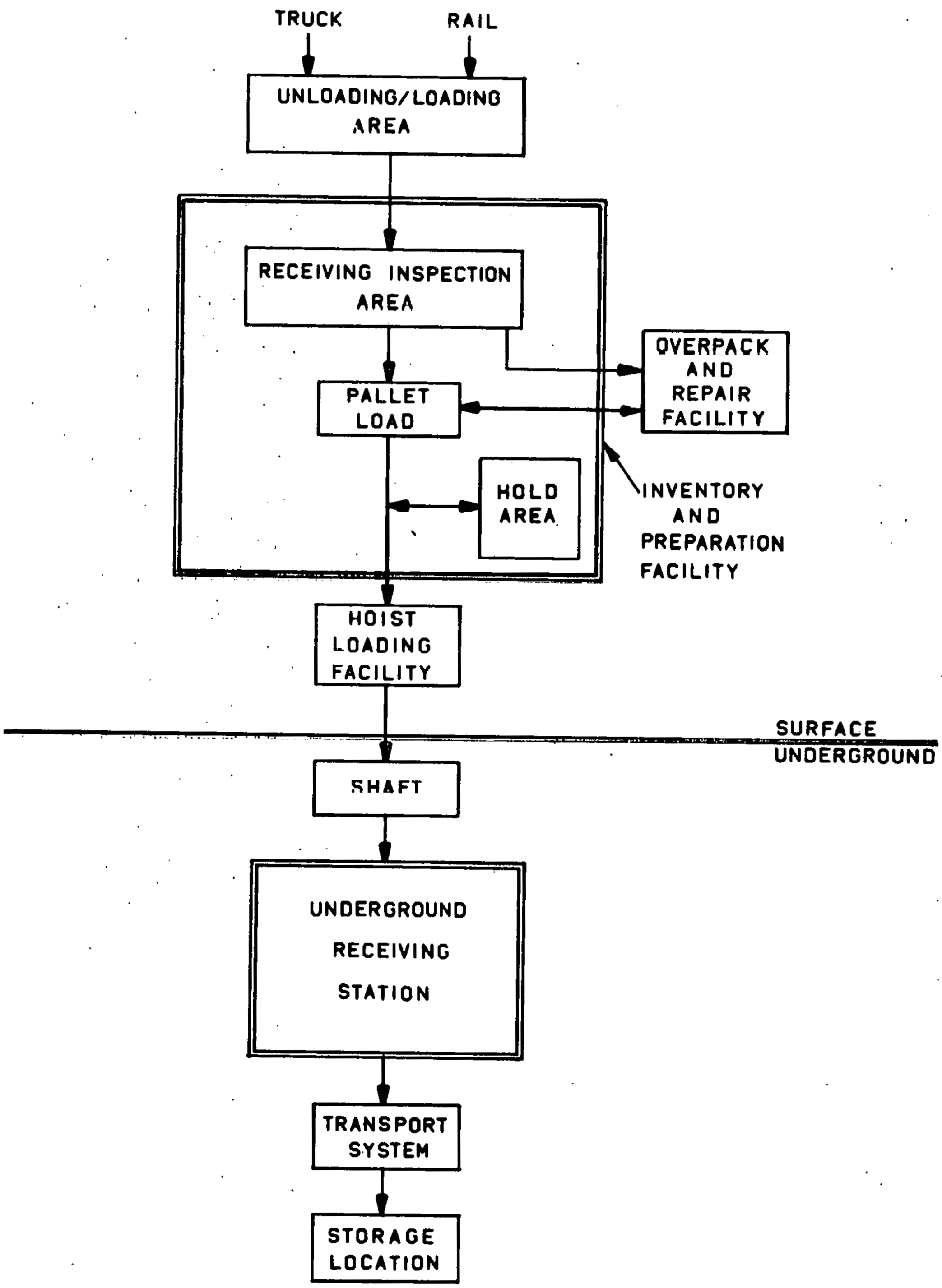


Figure II. 2-2-1. TRU waste-handling schematic

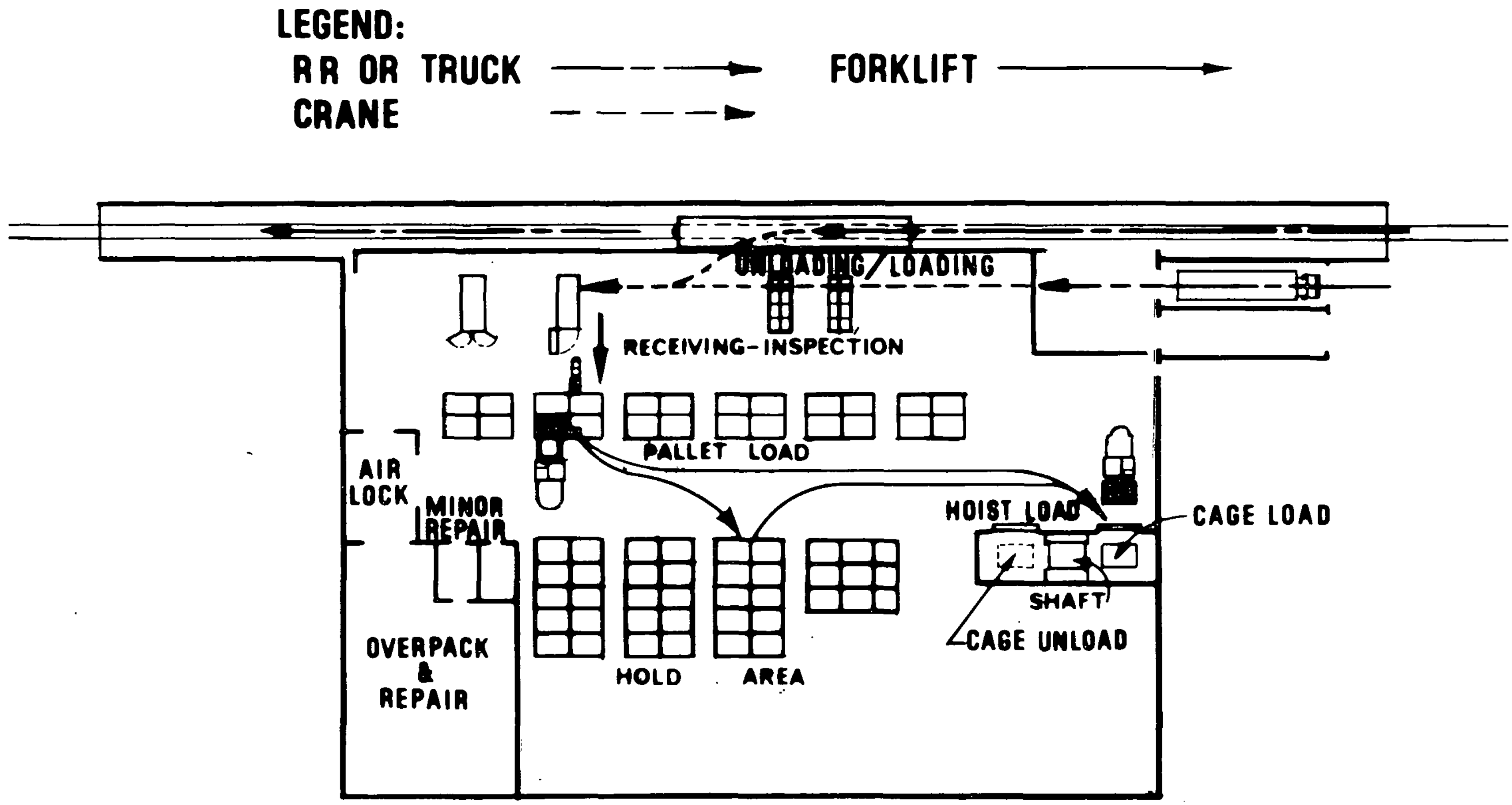


Figure II. 2-2-1-1. TRU waste normal flow diagram

TABLE II. 2-2-1-1

TRU Waste Facility Package Specifications

Item	Symbol	Dimensions (ft)			Maximum Weight (lb)			Shipping Method
		Length	Width	Height		Gross	Tare	
Supertiger Container	ST	20	8	8	UP	44,300	17,000	
					P	46,700	17,000	T/FC
Cargo Container	CC	20	8	8	UP	44,000	5,000	
					P	43,700	5,000	ATMX
Rocky Flats Fiberglassed Box	RF	7	4	4		10,000	---	ATMX
Overpack Fiberglassed Box	OB	8	5	5		11,000	1,000	ATMX
M3 Container	M3	5	4	6	UP	6,000	750	
					P	8,000	750	
					C	10,000	750	ATMX
55-gal Drum, DOT-17C	55D	2 Dia.	---	3	UP	650	---	
					P	900	---	CC/ST
83-gal Overpack Drum	83D	2.3 Dia.	---	3.2	UP	750	---	
					P	1,000	---	CC/ST

UP = Unprocessed Waste
P = Processed Waste
C = M3 bin--with contaminated waste

T = Truck
FC = Rail Flatcar
ATMX = Special Railcar

TABLE II. 2-2-1-2

Pallet Loading Configurations-TRU Waste Packages

Waste Container Type	Number of Containers Per Pallet	Weight of Each Container (lb)	Weight of Loaded Pallet (lb)
55-gal Drum--unprocessed waste	24	650	17,600
55-gal Drum--processed waste	24	900	23,600
83-gal Overpack Drum--unprocessed waste	15	750	13,250
83-gal Overpack Drum--processed waste	15	1,000	17,000
RF Box	2	10,000	22,000
Overpacked RF Box	2	11,000	24,000
M3 Bin--contaminated waste	2	10,000	22,000

All shipping containers will be loaded back onto the appropriate railcar, ATMX car, or truck trailer to be returned to the shipping agency.

2.2.1.2 Flow of Contaminated or Damaged Waste--Normal processing of wastes may be interrupted by the indication of airborne or surface contamination, or by the occurrence of damaged waste packages. These interruptions are handled as follows:

Presence of airborne contamination in an unopened shipping container requires moving the shipping container by crane to a wheeled dolly that then transfers the container to the overpack and repair room.

Partially loaded pallets or individual waste packages with surface contamination are moved to the overpack and repair room by forklift.

After decontamination or overpacking, the waste packages are palletized, moved to the pallet load area, inventoried and then entered in the normal process flow.

Uncontaminated damaged waste packages are moved to the minor repair room by forklift.

The repaired package is moved by forklift to the pallet load area and reentered into the normal process flow.

2.2.2 UNDERGROUND PROCEDURES AND EQUIPMENT FOR EMPLACEMENT AND RETRIEVAL OF TRU WASTE

2.2.2.1 TRU Waste Characteristics That Influence Underground Handling Procedures and Equipment Design

Radiation. Since TRU waste exhibits a low radiation level, the waste containers can be handled by contact methods. Radiation exposure to personnel is reduced by utilizing handling procedures that:

Minimize the time during which personnel are in close proximity to this waste.

Maximize the separation of work stations from any location where large quantities of this waste are accumulated.

Thermal Power Generation. The thermal power output of TRU waste is sufficiently low that it does not produce unacceptably high temperatures in the waste or in the surrounding salt medium if high packing density storage configurations are used.

2.2.2.2 TRU Waste Storing and Stacking Configurations (Ref. Drawing 94570-A7)

At the WIPP, TRU waste is stored in an underground complex consisting of 8 panels as shown in Fig. II. 2-2-2-1. One of the eight individual storage rooms within each panel is shown in Fig. II. 2-2-2-2. Large quantities of TRU waste are stored at the WIPP during the pilot phase; thus if a decision to retrieve TRU waste is made, considerable effort could be involved. To minimize the impact of a retrieval decision, the following two storage configurations are used.

Experimental Storage Configuration. At the onset of TRU waste receival at the WIPP, a small but statistically and experimentally adequate quantity of TRU waste is placed in storage rooms that are dedicated to experimentation. After an experimental room is filled with waste, the clearance space between the waste stack and the room will be filled with crushed salt to initiate studies of the behavior of TRU waste packages in direct contact with salt. Some waste containers are intentionally degraded or removed so that interaction between the waste and the salt will commence immediately. Backfilling also results in stress-induced creep closure of the room being coupled to the waste stack so that mechanical damage to individual waste containers due to this loading commences shortly after waste emplacement. (Figure II. 2-2-2-3 depicts this storage configuration.)

Bulk Storage Configuration. Most TRU waste received during the pilot phase of the WIPP is stored in rooms sufficiently oversized to prevent the waste from being locked-in by the stress-induced creep closure that will occur in the time period in which retrieval may be required. Note: This configuration is identical with the experimental configuration except for the salt backfill. If retrieval is not required, these rooms can be backfilled with salt, resulting in a configuration nearly identical to the experimental configuration; i.e., experimental results will be valid and directly applicable to this area (Reference Drawing 94570-A7).

2.2.2.3 TRU Waste Underground Transport and Handling Equipment

Transport Equipment. The loaded waste pallets are hauled from the underground receiving station to the waste storage sites with a straddle-lift trailer, a commercially available item modified for this specific task.

The prime mover for the straddle trailer is a diesel-powered, commercially available equipment tug with modifications to comply with mine and other safety requirements. Note: A general purpose tow vehicle is needed at other underground locations within the WIPP. This prime mover is designed to accomplish these tasks also. (Figure II. 2-2-2-4 depicts the TRU waste transporter.)

Handling Equipment. The TRU waste storage site is the only location underground where TRU waste is handled on a small lot basis. Forklifts are used at the storage site for handling TRU waste because of their inherent ability to accommodate various package configurations; they are diesel-powered and equipped with exhaust scrubbers to comply with mine regulations.

2. 2. 2. 4 Underground Handling Sequence for TRU Waste--Figure II. 2-2-2-5 represents those features of the underground TRU waste receiving station that are pertinent to off-loading the waste pallets from the TRU hoist cage and to subsequent pickup of the pallets by the TRU waste transporter. The basic operations that occur at the TRU waste receiving station are: 1) the TRU hoist cage is lowered to the unloading position and supported in this position by the cage landing chairs; 2) the doors of the cage are opened and the waste pallet is rolled out of the cage onto a conveyor to await pickup by the transporter. (Note: The unloading system is bidirectional; i.e., the cage can be unloaded from either side. Additionally, the conveyor systems are long enough to accommodate two pallets each); 3) the transporter is backed over a pallet and the transporter lift system lifts and secures the pallet. Figure II. 2-2-2-5 continues the sequence into the storage stack.

2. 2. 2. 5 Retrieval of Stored TRU Waste

Experimental Storage Configuration. Retrieval operations for those TRU wastes that were placed into the experimental configuration are complicated by the backfill salt, the intentional degradation of some waste packages at the time of storage, and the degradation occurring as a result of mechanical loading and exposure to the salt environment. For waste retrieval, the following process cycle is planned:

> Prior to start of retrieval, it is necessary to reestablish ventilation within the experimental waste storage area; additionally, it is necessary to locate a ventilation intake at the retrieval work face. The ventilation system shown in Fig. II. 2-2-2-6 uses the original ventilation exhaust drifts and provides a ventilation intake at the retrieval work face by means of piping and an axial vane suction fan.
>
> Relief saw cuts are made at each side and over the top of the waste stack. The proximity of these relief cuts to the waste stack is the minimum necessary to assure that the cuts do not contact the waste and that all radioactivity is encompassed (see Fig. II. 2-2-2-7).

The salt between the relief cuts and the waste is pried or chipped away from the waste stack to free the stack. This salt may be radioactively contaminated; if so, it is placed in sealable containers.

Waste containers are removed one at a time so that they can be inspected for integrity and surface contamination. If a container has been breached or is contaminated, it is overpacked at the retrieval site. Small quantities of waste intentionally emplaced without containers are retrieved by handwork, using controls and methods selected after a survey of the waste condition.

As retrieval progresses into the waste storage room, the floor of the room is checked for contamination and is cut away to a depth adequate to reduce contamination to an acceptable level; i.e., the general philosophy is to clean as the operation proceeds. The salt resulting from floor cleanup is placed into containers.

Bulk Storage Configuration. Retrieval of the major quantity of TRU waste stored in the WIPP (that which is placed in the bulk storage configuration) is by reversal of the installation process: i.e., by the use of conventional equipment and methods, since these wastes are not bound by the salt. Prior to start of retrieval, ventilation flow is reestablished through the aisleways in the waste stack by removing the bulkheads at the entrances to the waste storage room. These wastes are removed on a container-by-container basis so that each container can be inspected. If a container is found to be breached or is externally contaminated, it is overpacked at the retrieval site.

Safety Considerations. Retrieval operations for both categories of TRU waste are controlled by health physicists stationed at the retrieval sites. These health physicists will continually assess the conditions at the retrieval site and will mandate procedures and anti-C outfitting requirements for personnel.

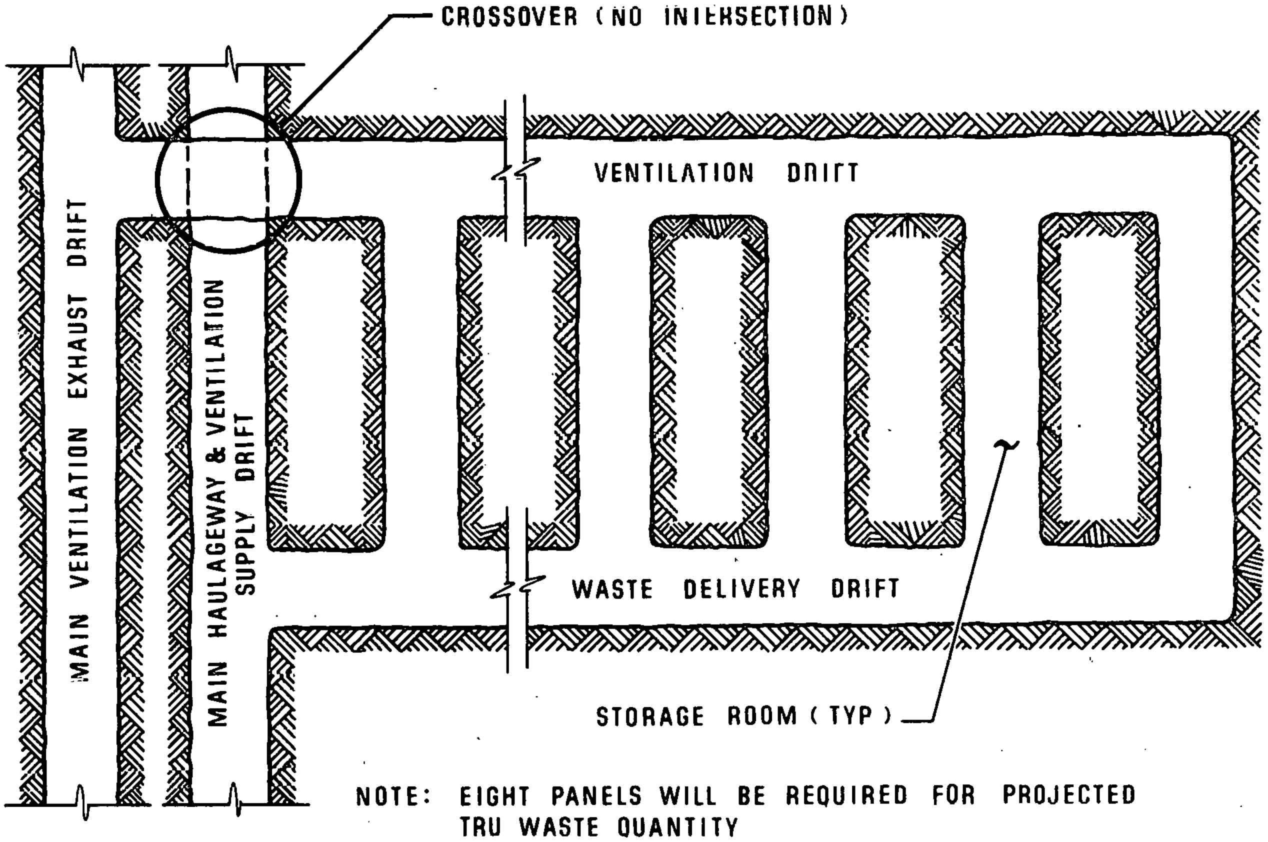


Figure II. 2-2-2-1. TRU waste storage panel (typical)

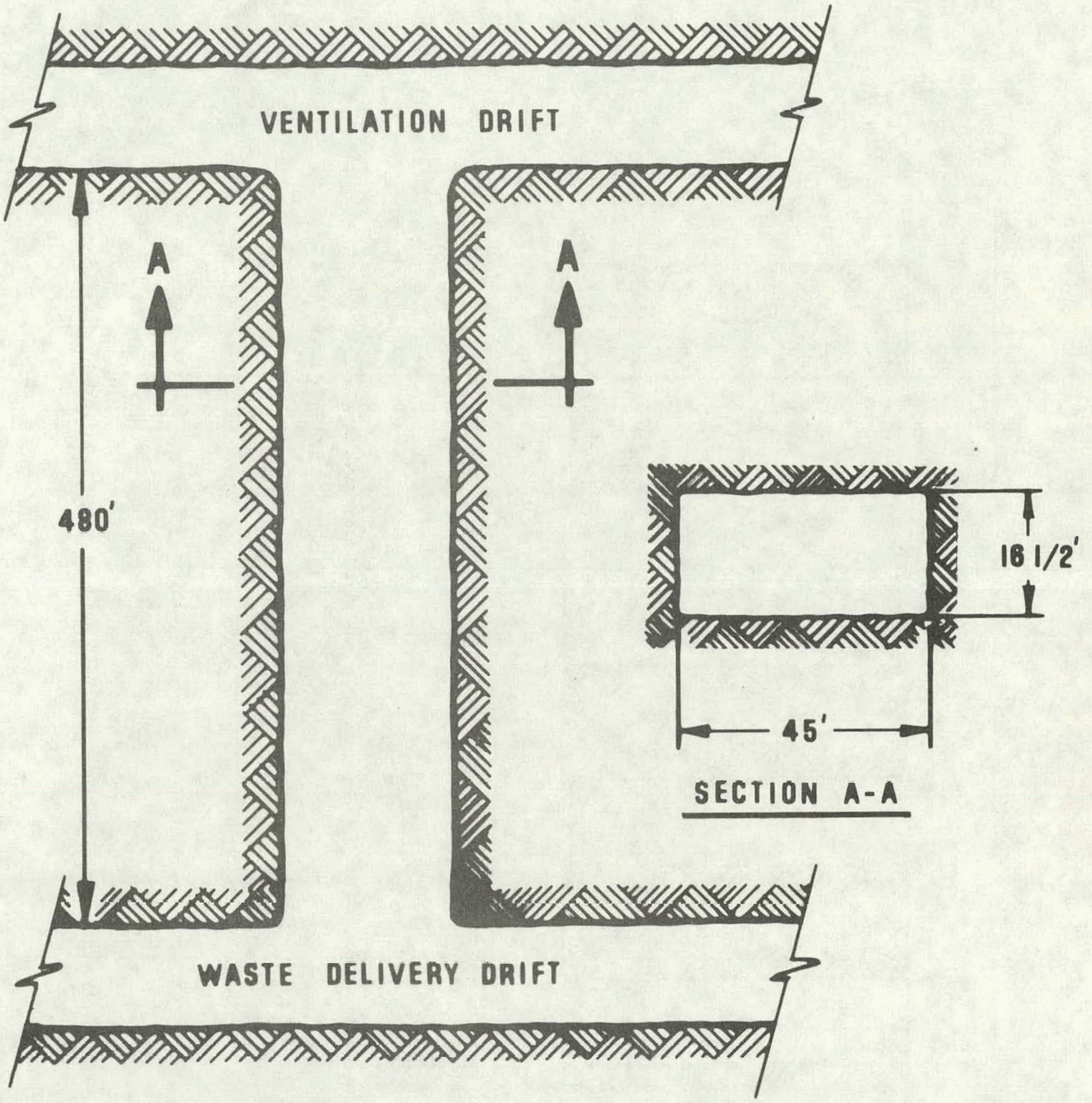


Figure II. 2-2-2-2. TRU waste storage room (typical)

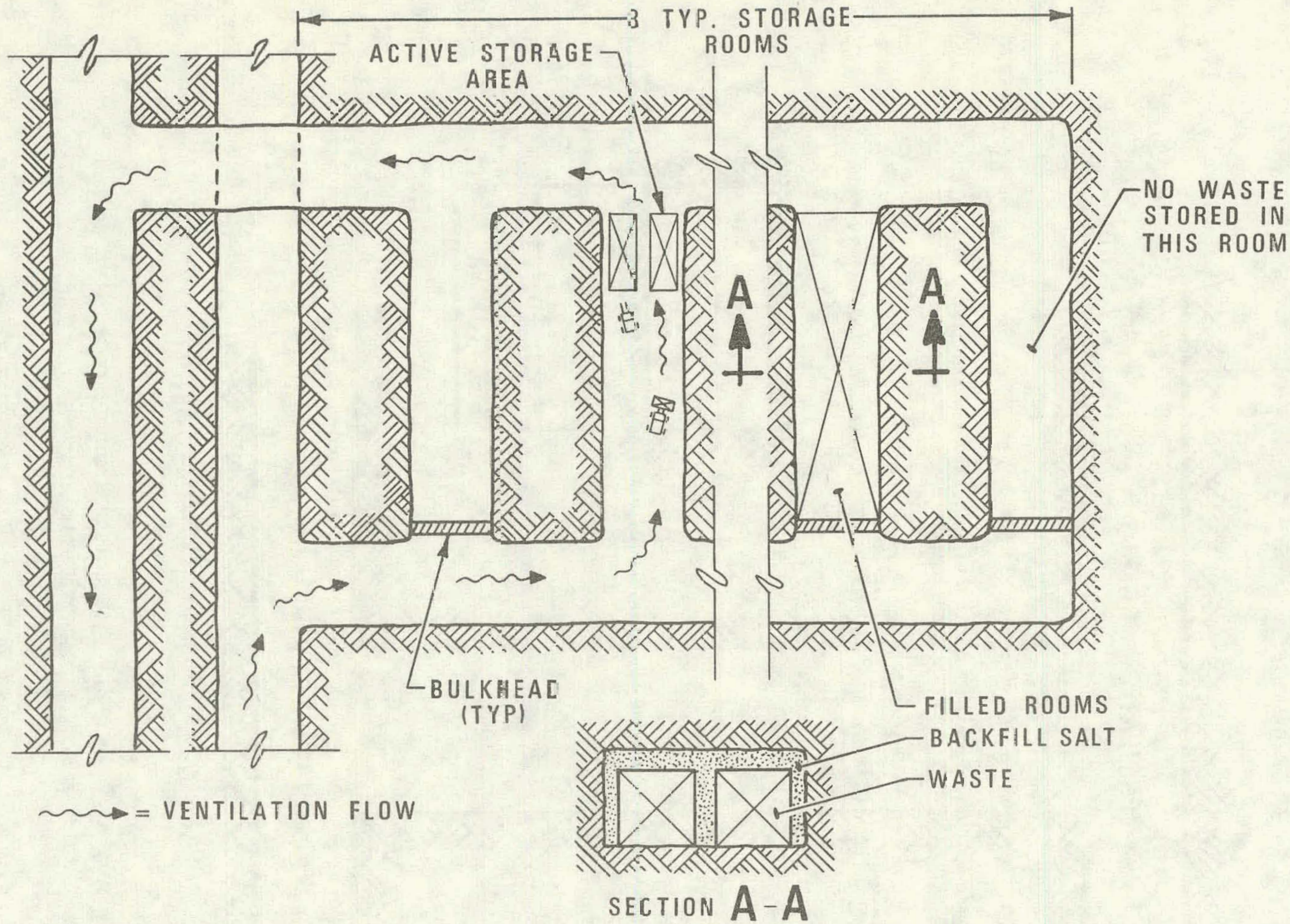


Figure II. 2-2-2-3. Experimental TRU waste storage configuration

TRANSPORTER DESCRIPTION

1. OVERALL SIZE
   - LENGTH - 26 FT. 6 IN.
   - WIDTH - 11 FT.
   - HEIGHT - 7 FT. 6 IN.
2. MAXIMUM PAYLOAD CAPACITY AND SIZE
   - WEIGHT - 25,000 LBS.
   - SIZE -- 8 FT. 6 IN. WIDE BY 12 FT. 6 IN. LONG BY 5 FT. 6 IN. HIGH
3. PRIME MOVER
   - DIESEL POWERED, EQUIPPED WITH BUREAU OF MINES APPROVED EXAUST SCRUBBER

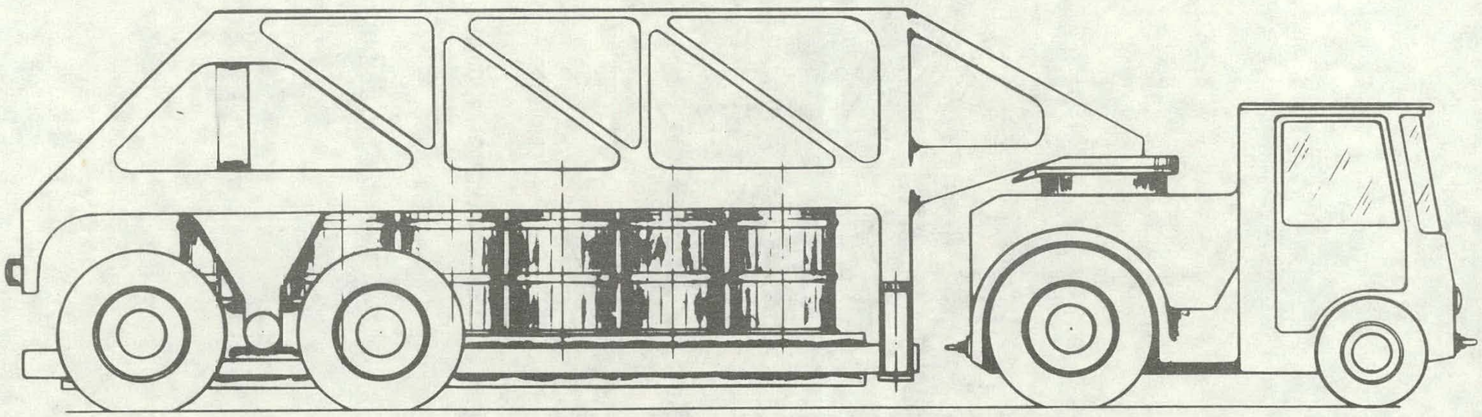


Figure II. 2-2-2-4. TRU waste transporter

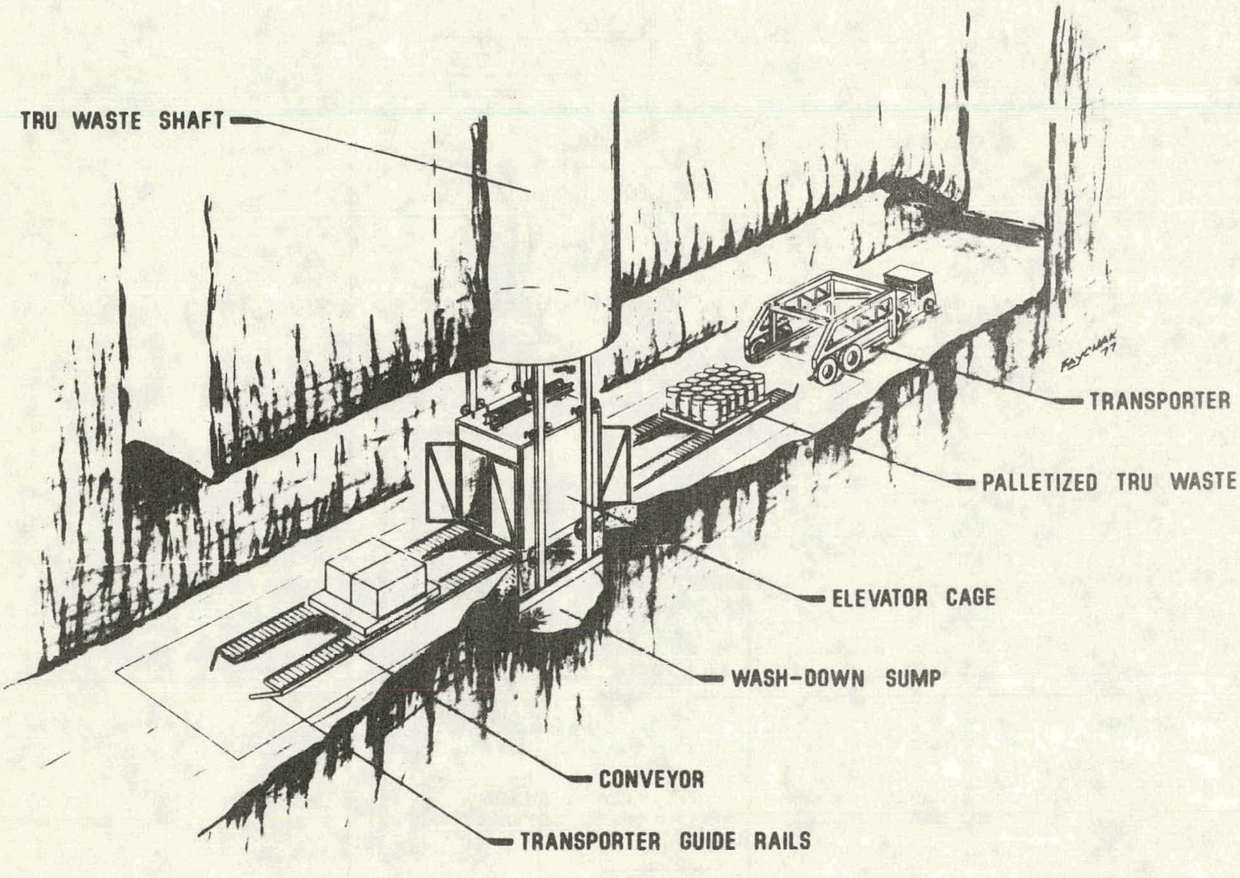


Figure II. 2-2-2-5. WIPP underground TRU waste receiving station

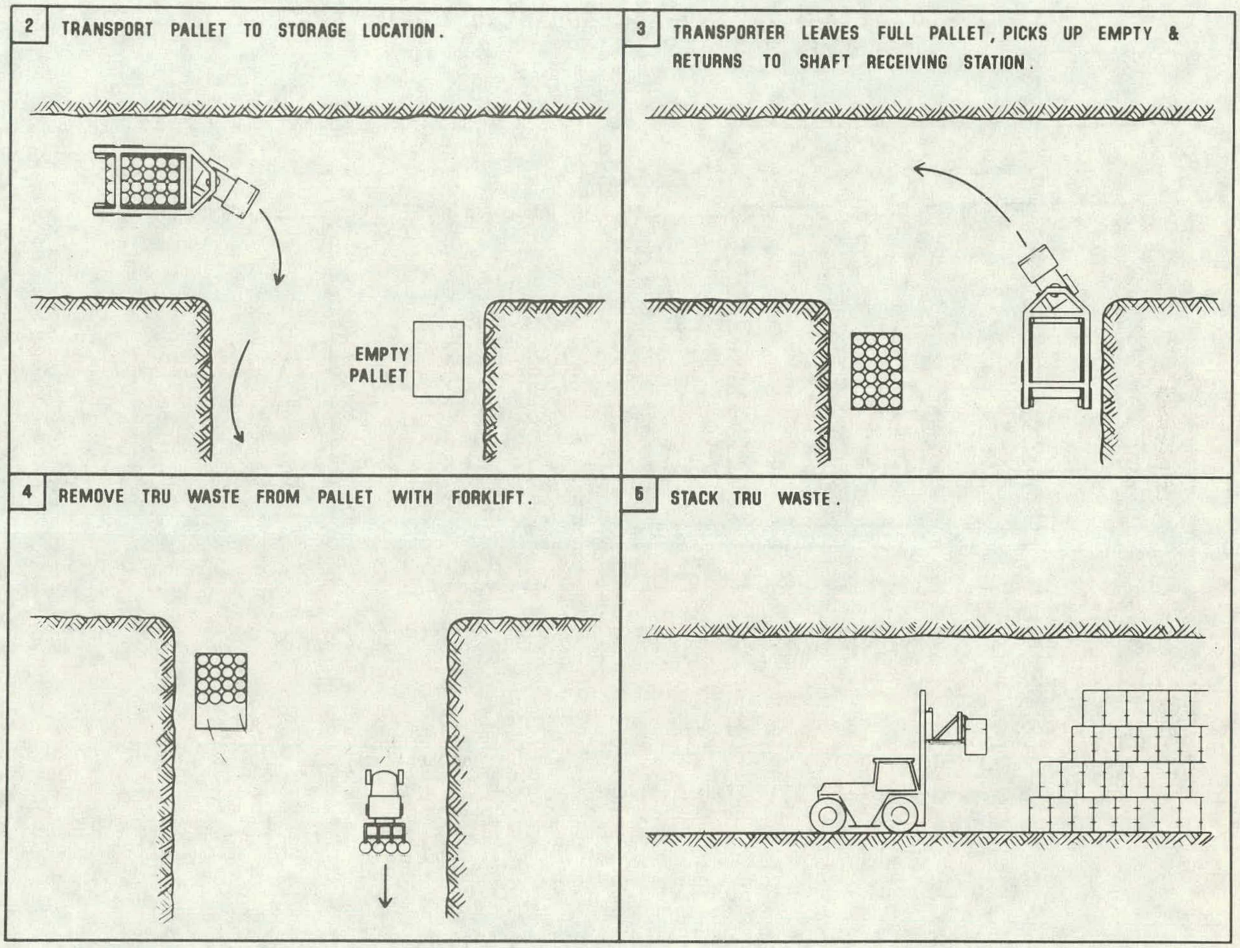


Figure II. 2-2-2-5 (continued)

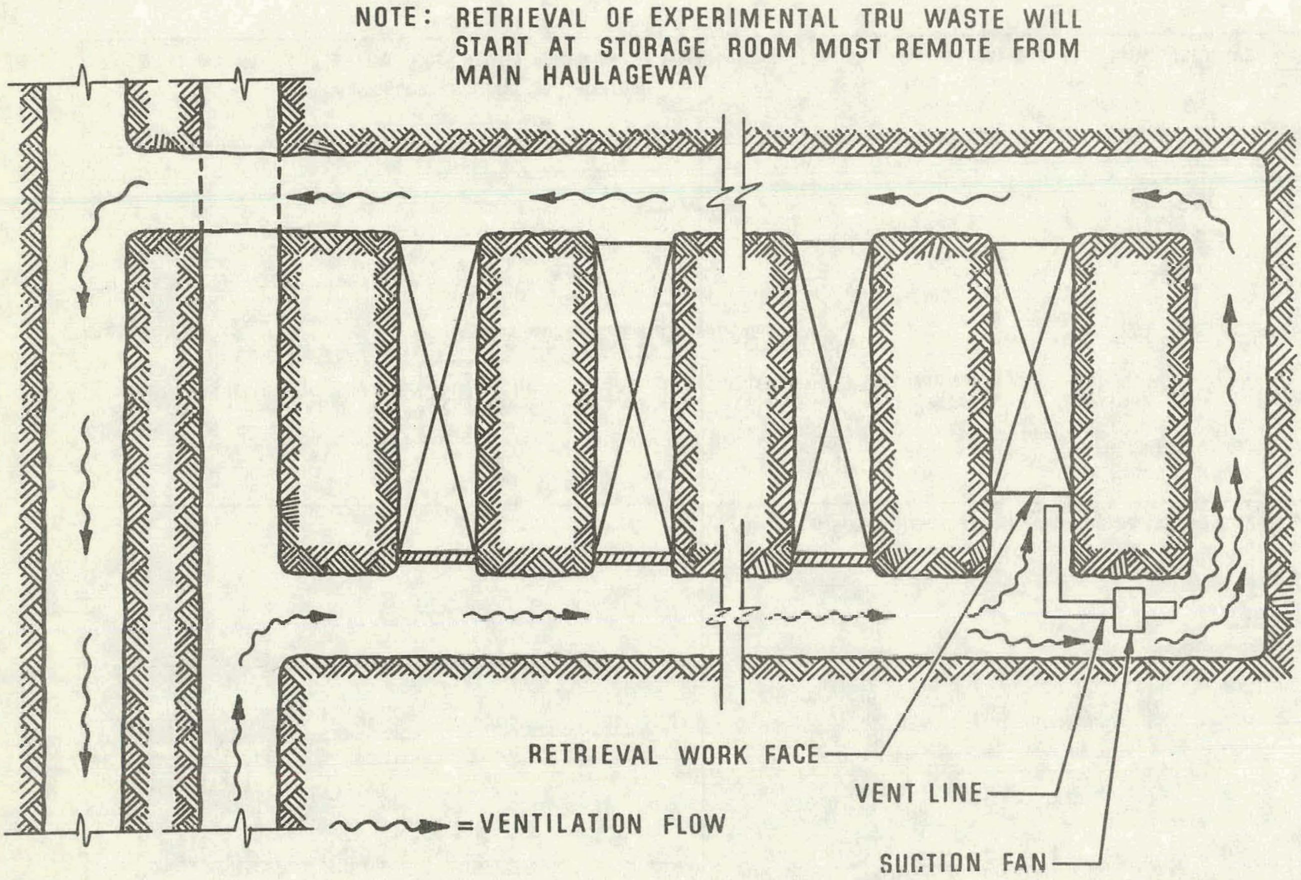
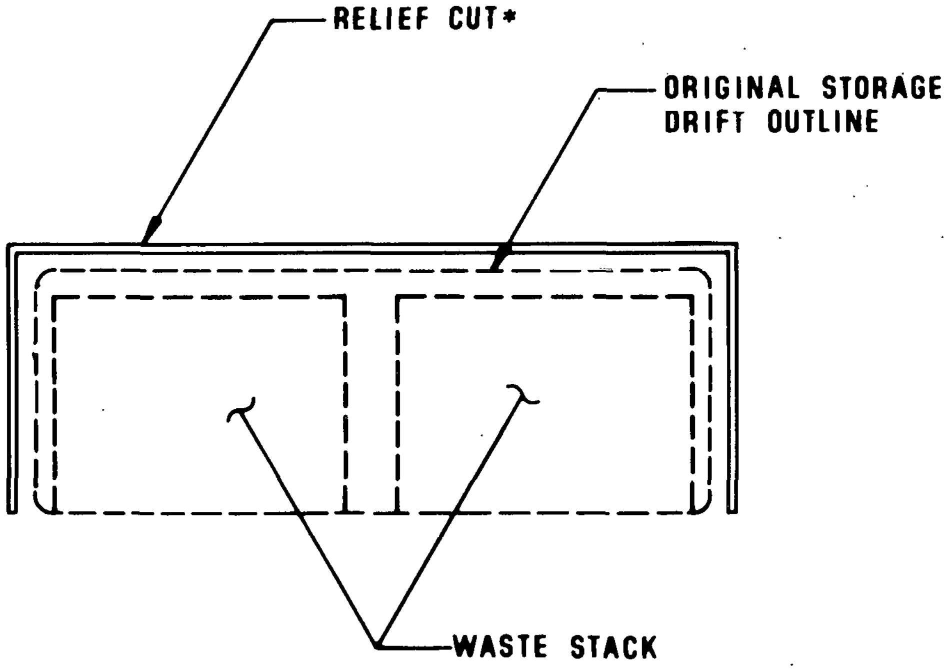


Figure II. 2-2-2-6. Ventilation system for experimental TRU waste retrieval



*RELIEF CUTS WILL BE MADE BEYOND MAXIMUM EXTENT OF RADIOACTIVE MATERIAL MIGRATION. INITIAL CUTS WILL BE APPROXIMATELY 10 FEET DEEP; WASTE RETRIEVAL WILL PROCEED TO FULL CUT DEPTH AT WHICH POINT, NEW CUTS WILL BE MADE.

Figure II. 2-2-2-7. Experimental TRU waste retrieval

2.3 REMOTE HANDLING (RH) WASTE FACILITY

2.3.1 SURFACE FACILITY

The Remote Handling (RH) Waste facility, as shown in Drawing 94540, provides facilities for personnel and equipment involved in the transfer of RH waste from incoming waste shipping casks to the mine shaft. The hot-cell and clean-cell arrangement will allow expansion of the facility by the addition of up to three hot cells leading into the common clean cell. The majority of this facility is a tornado-missile-hardened structure constructed of poured-in-place concrete, with all fenestrations protected to prevent the penetration of tornado-borne missiles. The building is divided into the major areas described below:

Area	Function
Shipping/Receiving High Bay	Receiving and shipping (by truck or rail) of radioactive waste shipping casks.
Cask Transfer Gallery	Transfer of casks from the high-bay receiving area to the cask preparation/decontamination area via the cask transporter vehicle. Acts as a tornado-missile-protected airlock between the two areas.
Cask Preparation/Decontamination	Space for five cask cooldown and storage stations and one cask decontamination station. Two rail-mounted cask transporter vehicles move casks within this area. A 110-ton crane is also provided.
Cask Elevator Room	Acts as an airlock to separate the preparation/decontamination room from the hot cell and to provide space for the cask elevator and its associated equipment.
Hot Cell	Receipt, inspection, transfer, repair, and temporary storage of radioactive waste canisters. All waste-handling operations in the hot cell are performed using remote-controlled cranes and manipulators. A shielded crane repair station and a HEPA filter bank are included.
Canister Decontamination Room	Space for the rail-mounted canister decontamination vehicles. All canisters are decontaminated in this room before transfer to the clean cell.

Area	Function
Clean Cell	Remotely operated transfer of clean canisters from the decontamination room to the mine cage transfer vehicle.
Administration and Technical Offices	Administrative functions to support the RH facility, including space for files, administrative personnel, a conference room, men's and women's toilets, and janitor's closet. Movable office partitions based on a 4' x 6' modular layout are used.
Health-Physics/Lockers and Showers	Space for health-physics and cask-handling personnel, health-physics functions, men's and women's showers, lockers, dressing areas, toilets, and an anti-contamination (anti-C) clothing storage/issue area.
Mechanical Equipment Room	Space for site-generated solid and liquid radioactive waste handling equipment, the shipping cask cooldown system, personnel radiation monitoring and anti-C clothing disposal.
HVAC Equipment Room	Space for the heating, ventilating, air conditioning, and filtration systems described in Section 2.3.1.3.
Upper Sheave Room/ Head Frame	The upper hoist sheave and sheave supports are located in this area and function as the RH hoist head frame.
Lower Sheave Room	The lower hoist sheave, mine shaft man cage access corridor, and hoist cable access tunnel are located in this room.

2.3.1.1 Architectural

Functional Space Requirements. Space requirements are in accordance with the following:

Room Area Description	Area (sq ft)	Minimum Overhead Clearance (ft)
-29-ft Elevation		
Lower Sheave Room	772	30
-16-ft Elevation		
Stairway	366	10
Mechanical Equipment Room	2478	26
Health Physics	196	10
Preparation and Decontamination	5408	26
Corridor	390	10
Duct	384	10
Decontamination Rooms	384	24
-8-ft Elevation		
Stairway	366	10
Storage	80	10
Anti-C/Showers/Locker Room	104	8
Toilets/Janitor's Closet	472	8
Corridor	528	10
+4-ft Elevation		
Shipping/Receiving High Bay	6723	56
Offices	1052	10
Toilets/Janitor's Closet	320	8
Stairway	306	10
Vestibule/Lobby	224	10
Conference Room	192	10
Corridor	912	10
Control Room	1272	10
Hot Cell	1680	48
Clean Cell	1368	48
+26-ft Elevation		
HVAC Room	8137	28
+64-ft Elevation		
Upper Sheave Room	392	24

Building Materials. A summary of building materials is contained in Section 4.14.

2.3.1.2 Structural (Surface)--The building is designed for the Category I classification except for the following Category II areas:

- Shipping and receiving high-bay area
- Cask transfer gallery, except that the entrance and exit hatches are designed to resist the design-basis tornado differential pressure loading.

The structural framing is typically a poured-in-place reinforced concrete system. The floors and the roof are beam and slab systems supported on concrete columns and concrete-bearing walls (see note below). A hoist system upper sheave room located directly above the mine shaft is included in the building. The shipping and receiving high-bay area is a structural steel beam and column system supporting a metal roof deck and metal siding attached to structural steel purlins and girts.

The foundations are typically a system of individual column and continuous-wall spread footings. Combined mat footings bearing directly on grade are required in some areas.

Note: The minimum thicknesses of concrete required to resist the design-basis missile in the roof and exterior wall areas are 17 and 18 in., respectively. These minimum concrete thicknesses are applicable to all areas of Category I structures that are exposed to tornado-induced missiles.

2.3.1.3 Mechanical

Domestic Water System. The estimated cold-water demand required to serve this facility is ~76 gpm. A connection to the domestic water main is provided as shown on Drawing 94534-C1. Domestic hot water for the facility is provided by solar collectors in conjunction with the building heating system.

Soil, Waste and Vent System. A standard soil, waste and vent system serves building toilet rooms, locker rooms and showers, janitors' closets and is used for other normal services.

Compressed Air. Compressed air is piped to work stations in the facility.

Special Systems. The following systems require interior piping:

- Canister decontamination system
- Shipping cask cooling system
- Shipping cask decontamination and washdown stations
- Liquid waste collection tank
- Floor drains in waste handling areas

The systems are designed to carry the liquid wastes to a 15,000-gal holding tank in the mechanical equipment room. Liquid is pumped from this tank to the Suspect Waste/Laundry building.

HVAC System. Table II. 2-3-1-1 contains a summary description of the HVAC system in this building.

2.3.1.4 Electrical--The RH Waste facility electrical system is described in Section 4.2 and Drawings 94540-E1 and -E2. The facility electrical loads are described in Table II. 4-2-1-1 and Addendum E. As in other WIPP facilities that handle wastes, the RH electrical loads are classified as both normal and vital. The breakdown of the loads is included in Table II. 4-2-1-1.

2.3.1.5 Material Handling Equipment--The RH Waste surface facility includes the equipment listed in Table II. 2-3-1-2 for handling the RH radioactive waste material shipped to WIPP for storage.

Special Systems. Special systems designed especially for the WIPP are described in detail in Addendum J. A summary of the major systems follows:

- Shipping Cask Cooling System. The shipping cask cooling system shown in Drawing 94540-P3 cools high-level waste shipping casks before waste canisters are unloaded from the casks. System components are located in the mechanical equipment and preparation/decontamination rooms of the RH Waste facility as shown on Drawings 94540.

Both dry and wet shipping casks may be received at WIPP. Dry casks are vented to the gaseous radioactive waste system (Section 4.11.3) following connection to the casks with flexible, quick-disconnect hoses at the cooling station. No cooling is performed on these casks. The wet casks and the canisters they contain are cooled by a closed-cycle pressurized water system in three phases: vaporization of preheated water, reduced pressure boiling, and liquid cooling to final desired cask surface and internal temperatures. To initiate cooling, the cask is positioned in a storage station in the preparation/decontamination room. The procedure for cooling wet shipping casks is given below:

Vaporization of Preheated Water. Water supplied from the feed tank and heated in the electric feed heater to 400°F flows into the cask. This preheating limits temperature differentials and thermal stresses in the cask internals and waste canisters. The water vaporizes in the shipping cask and flows as steam to the steam feed preheater for condensation while it preheats the feed fluid. The electric heat load is then reduced to the level required to provide water to the cask at 400°F. This phase is completed as the cask begins to fill with water.

TABLE II. 2-3-1-1

HVAC Systems

The following table describes the RH Waste facility HVAC system. General characteristics of the radwaste handling facilities HVAC systems are described in Section 4. 1. 2. Bases for selecting specific system energy conservation components are discussed in Addendum F, HVAC Energy Study. (See Drawings 94540-A1 through A4 and M1).

Area	Design Objective	Ventilation Concept	Heat Gain and Loss Assumptions	Equipment Selection.
Shipping/Receiving High Bay	To maintain a pressure differential between area and atmosphere. To control diesel exhaust fumes.	Inlet air is rough-filtered, heated or cooled and introduced at a high elevation. Inlets have pressure-control dampers to maintain area below atmospheric pressure. Air exhausts through drained, grated trenches at the building floor level and discharges to atmosphere. Airflow requirements are based on 4 air changes/hr.	Inlet air is tempered by exhaust-air heat reclamation and by evap. cooling. No specific temperature is maintained.	Supply air handling units: Washable metal mesh prefilters, roughing filters, evap. cooling sprays, heat reclaim coils and supply fans. Exhaust air handling units: Roughing filter, heat reclaim coils, exhaust fan.
Cask Preparation/ Decontamination	Temperature control. To entrap airborne contaminants generated in cask preparation/decon operations. To maintain a pressure differential between area and adjoining spaces.	Inlet air is rough-filtered, heated or cooled and introduced at a high elevation. Inlets have pressure-control dampers to maintain area pressure below shipping/receiving area pressure and above hot-cell pressure. Air exhausts through drained, grated trenches at floor level so that no operations occur between casks and exhaust trenches. Air discharges through a HEPA filter bank to central exhaust stack. Air inlets/outlets have tight shutoff dampers for emergencies. Air-flow requirements are based on 6 air changes/hr.	Lighting: 4 W/ft^2 Casks: 48 cans @ 3. 5 kW dissipation Hoists: one 160-hp @ 10% usage factor Carts: two 10-hp @ 100% usage factor Turntable: one 5-hp @ 10% usage factor Water Wash: one 20-hp @ 50% usage factor People: 4 working @ 300 Btu sens. + 2 mod. act. @ 250 Btu sens.	Supply air handling units: Washable metal mesh prefilters, roughing filters, heating/cooling recovered energy coils, evap. cooling sprays, supply fans. Exhaust air handling units: Water sprays and mist eliminators, 2 stages of roughing filters, 3 stages of HEPA filters, and airfoil-type fans.

TABLE II. 2-3-1-1 (cont)

Area	Design Objective	Ventilation Concept	Heat Gain and Loss Assumptions	Equipment Selection
Hot Cell	To entrap airborne contaminants generated by the various operations. Temperature control. Removal of decay heat from stored waste canisters.	Inlet air is rough-filtered, heated or cooled and introduced at a high elevation. Inlets have pressure-control dampering to maintain area pressure below the cask preparation/decon pressure. Air exhausts through HEPA filters mounted in floor openings, through openings in bottom of canister storage pits, and discharges through a HEPA filter bank and the central exhaust stack. Air inlets/outlets have tight shutoff dampers for emergencies. Airflow requirements are based on 6 air changes/hr.	Lighting: 4 W/ft^2 Casks: 8 cans @ 100% + 10 cans @ 50% (3.5 kW/can) Hoist: 40 hp @ 10% usage Misc. motors: 10 hp @ 50% usage	Supply air handling units: Washable metal mesh prefilters, roughing filters, heating/cooling/recovered energy coils, evap. cooling sprays, supply fans. Exhaust air handling units: Water sprays and mist eliminators, 2 stages of roughing filters, 3 stages of HEPA filters, and airfoil-type fans.
Clean Cell		Ventilation of the clean cell is by air flowing from the mine shaft up through the clean cell and into the headframe enclosure.		
Canister Decon Room	To entrap airborne contaminants. To remove heat generated by the decon equipment.	Inlet air is rough-filtered, heated or cooled, and then introduced through sidewall inlets. Inlets have pressure-control dampering to maintain area pressure below hot-cell pressure. Air exhausts through sidewall outlets at floor level through a HEPA filter bank to the central exhaust stack. Air inlets/outlets have tight shutoff dampers for emergencies. Airflow requirements are based on 70 air changes/hr.	Lighting: 4 W/ft^2 Casks: 2 cans @ 3.5 kW Pumps: 2 @ 60 hp @ 100% usage Brushes: 2 @ 25 hp @ 100% usage	Supply air handling units: Washable metal mesh prefilters, roughing filters, heating/cooling/recovered energy coils, evap. cooling sprays, and supply fans. Exhaust air handling units: Water sprays and mist eliminators, 2 stages of roughing filters, 3 stages of HEPA filters, and airfoil-type fans.

TABLE II. 2-3-1-1 (cont)

Area	Design Objective	Ventilation Concept	Heat Gain and Loss Assumptions	Equipment Selection
Headframe Enclosure	To maintain upcast airflow in the mine shaft, and airflow in the clean cell and the cable tunnels from the hoisthouse to the hoist headframe enclosure.	Inlet air for the mine shaft is drawn from the mine and filtered by roughing and HEPA filters before entering the shaft. Air exhausts from the head-frame enclosure and discharges through a HEPA filter bank to the central exhaust stack. Inlet air to the headframe enclosure comes from the clean cell and the hoisthouse by cable conduits. Static pressure and airflows are controlled by inlet dampers on exhaust fans and inlet dampers at the hoisthouse. The headframe enclosure is maintained at a sufficient negative pressure to ensure required upcast flow through shaft. Air inlets/outlets have tight shutoff dampers for emergencies. Temperature control is not needed.	None	Exhaust: Same as the equipment described for the cask preparation/decon area except that exhaust fans are equipped with inlet vane dampers.

TABLE II. 2-3-1-2

Material Handling Equipment for RH Waste Facility

Location	Equipment Item	Qty.
Shipping/Receiving High Bay	110-ton bridge crane	1
Cask Preparation/Decontamination	110-ton bridge crane	1
	Cask transporting vehicles (see Drawing 94540-M3)	2
	Shipping cask pallets (see Drawing 94540-M4)	5
	Vehicle turntable	1
	Shipping cask elevator (see Drawing 94540-M3)	1
	Shipping cask decontamination equipment	1
Hot Cell	25-ton X-Y coordinate programmed bridge crane	1
	Remote manipulator with telescoping tube, carriage and bridge system	1
	Master-slave manipulator	1
	Remotely operated canister overpack welding machine (see Drawing 94540-M5)	1
	Vacuum autoclave overpack leakage tester	1
	Canister storage pits	8
Canister Decontamination Rooms	Canister decontamination vehicle (see Drawing 94540-M6)	1 ea.
	Remote operated closed circuit TV cameras	1 ea.
Clean Cell	20-ton X-Y coordinate programmed bridge crane	1
	Remote manipulator with telescoping tube, carriage and bridge system	1
	Canister pallets	8
	Mine shaft cage carousel	1

Reduced Pressure Boiling. The cask is kept full of water, and its pressure is controlled to allow heat removal by boiling.

Liquid Cooling. When the temperature of the water in the cask falls to about 210°F, the last phase of cooling begins. This phase is used for storage and to assure that water in the cask does not flash to steam when the cask lid is removed in the hot cell. In this phase the cask is completely flooded; liquid enters, is heated, and exits. The liquid then flows to the liquid receiver via the cooler. Makeup water for this system is provided from the recycle water system (Section 4.11.1.4). Cooling system vessel relief valves discharge to the RH Waste facility collection tank for monitoring by in-line instrumentation. Water quality is maintained by feed-and-bleed operations and by system filters and is drained as necessary to the RH Waste facility collection tank for processing through the liquid radwaste system. All system equipment is sized for heat removal from the maximum number of casks that can be cooled in a single-shift operation. Tanks and heat exchangers are constructed from stainless steel.

- Canister Inspection and Overpack System. RH waste may be received at the WIPP in double-canister containers. All canisters are inspected visually and swiped. If damage or excessive contamination is indicated, an evaluation of closure weld integrity and canister leak tightness is performed. Weld integrity is best determined by ultrasonic testing. A vacuum autoclave is used to leak-test the suspected canisters. Additional development work will be done for these equipment items during Title I design.

Canisters that require an overpack are placed in an overpack container; then an overpack container head is welded in an inert (helium) atmosphere onto the container by a remotely operated enclosed welding machine (see Drawing 94540-M5). The vacuum autoclave mentioned above is used to leak-test the overpack canister seal weld.

Overpacked canisters are decontaminated in the same way as normal canisters and are then transported to the mine for storage.

- Canister Decontamination System. This system (see Drawing 94540-M6) decontaminates all canisters and overpacks before they enter the clean cell. The control station for the system is located in the hot- and clean-cell control room and contains equipment and controls necessary to operate the canister decontamination system.

Two identical rail-mounted decontamination wells (stainless-steel enclosures 4 ft in diameter by 18 ft high equipped with inflatable seals at their tops) are located in an enclosure below the remote-handling cells. Power and piping connections are made with flexible lines. Pumps, filters, and tanks are located at the bottom of the enclosure. A large-diameter pipe at their tops allows steam to pass to a vapor condenser. A return air blower maintains circulation.

Inside the wells, vertical rollers mounted on scissor jacks center the canisters, and two tapered rollers form the bottom supports. One tapered roller shaft driven by an air or electric motor rotates the canister by friction drive. The scissor-jack rollers center the canister before degrappling and permit handling canisters between 16 and 26 in. in diameter. A high-pressure water manifold rigidly mounted between the adjustable rollers contains 12 nozzles to spray every part of the canister with water at 1000 psi. The top section of the spray nozzles is rotatable.

Adjustable motor-driven vertical brushes with alternate overlapping coverage are circumferentially mounted inside the wells. The section containing these brush units can be removed for maintenance.

The bottom of the well funnels the decontamination water into a tank that provides for water cooling to 150°F and automatic water level control from the makeup system. A booster pump rated at 50 gpm at 100 psi pumps water from the tank through coarse filters to a shielded absolute filter; a high-pressure pump then boosts the pressure to 1000 psi. The water then passes through a radiation monitor before entering the flexible supply line for the decontamination spray nozzles. A low-pressure pump transfers contaminated water to the liquid waste disposal system.

Tanks located in the canister decon cell access corridor supply gaseous nitrogen to the system for backflushing liquid filters to remove contaminated residue. Contaminated residue is carried into the solid waste disposal manifold.

Canister Decontamination Process

Move the decon vehicle to the decon cell inlet port, activate its inflatable seal and open the decon cell inlet port door.

Lower the canister into the enclosure, where idler rollers center and stabilize the canister. Release the canister and close the inlet port door. Inflate the inlet port seal and actuate the high-pressure water system.

When radiation monitor readings indicate that the canister is clean, shut off the high-pressure water system. Deflate the vehicle seal and move the vehicle to the clean cell inlet port.

Inflate the vehicle seal and open the clean cell inlet port door. The overhead crane grapples the canister, the idler rollers disengage, and the canister is raised into the clean cell.

The secondary wire brush decon system engages during the cleaning process only if the primary water cleaning system radiation monitor indicates continued contamination after completion of the high-pressure water cleaning cycle.

2.3.2 SHAFT AND SHAFT CONVEYANCES

This shaft connects the clean cell in the RH surface facility with the transfer cell on the RH level and is used to move RH waste canisters. Its design was governed by the size, configurations and quantities of RH waste receivals. A time-and-motion analysis confirmed that the system would handle the design quantities (see Addendum A).

2.3.2.1 Shaft--The 8-ft diameter, 2800-ft deep circular shaft (see Drawing 94567-A1) is lined with concrete from the surface to and including the first 15 ft of the Salado formation. A water ring is provided at this level, and the shaft is unlined the rest of its length except for its lower 66 ft. The shaft bottom is 44 ft below the RH level.

Water Collection System. The system is identical to that installed on the TRU shaft.

Headframe. The headframe is an integral part of the RH surface facility and is shown on Drawings 94540.

Transfer Cell. The underground transfer cell (see Drawing 94567-A2) is an integral part of the RH shaft. The cell is similar to the clean cell on the surface and has all necessary equipment for transfer of the canisters from the shaft conveyance to the RH waste transporter. The roof of the cell can withstand the loads imposed on it by the transporter during this operation. Only a cell decontamination system is provided, and modifications to include overpack equipment will be required if a major retrieval program is necessary. A shielded isolation cell allows personnel access if required while canisters are in the cell. Interlocks on all airlocked openings prevent short circuiting of air flows.

2.3.2.2 Shaft Conveyance--The RH shaft conveyance (see Drawing 94567-M2) includes a safety brake unit, a man cage and a canister container. The man cage is used primarily for shaft decontamination and was made an integral part of the normal conveyance due to difficulties in attaching and removing the cage when required. The weight of the RH conveyance is ~19,000 lbs.

Guide System. Lock coil rope guides rigidly fastened at both ends are used since maintenance access in this shaft is severely restricted. Compression springs at the upper fastening points maintain the proper rope tension. Supplemental rigid guides are installed in the clean cell and transfer cell. The anchorage system and the shaft collar design are shown on Drawing 94567-M1.

Hoist Safety System. Safety equipment includes a slack hoist-line trigger, an overspeed governor, an automatic rate of deceleration control and a velocity and distance travel sensor that continuously computes the remaining distance to the underground transfer cell and transmits this information to the hoisthouse. The sensor actuates the brakes to slow down and stop the load if the hoist fails to slow down as the load approaches the bottom. Should the load overspeed, a governor mounted on the hoist drum actuates the drum brakes.

Cage Safety System. In the event of an accident, this system can decelerate the conveyance and then slowly lower it to the transfer cell. Two safety ropes anchored at the top of the headframe extend down to safety drums mounted in the bridle of the shaft conveyance where they are wound around separate grooved drums and then extended down to the shaft bottom. The ropes are tensioned and anchored beneath the bottom of the underground transfer cell. Two safety drums are installed on each safety rope. As the shaft conveyance is raised and lowered during normal operation, the safety drums rotate freely, but are braked in the event of an emergency. Each drum has electrically actuated internal expanding brakes with a storage battery and generator to furnish the necessary power. No power is consumed from the batteries during normal operation.

The safety unit contains a hoist rope drawbar that is spring loaded with the slack hoist-line trigger. If the hoist line breaks, the slack-line trigger actuates the brakes, and the free-falling load is brought to a stop at a preset rate of deceleration. The brakes can also be manually actuated from within the man cage.

Hoist. The RH hoist was designed for the required loads, and rates of movement. The system has these features:

Type of hoist	Single drum (unbalanced)
Net capacity (tons)	12.5
Hoist rope diameter (in.)	1.75
Hoist rope safety factor	4.5
Drum diameter (in.)	140
Drum face width (in.)	95 (with two rope layers)
Total motor hp	700

2.3.3 RH UNDERGROUND LEVEL

The RH level development (see Drawings 94568-A1 through -A3) encompasses an area of ~570 acres of which about 220 acres are used for storage and ~20 acres for experiments. It is south and southwest of the shaft area and as near the 1260-ft-radius shaft pillars as possible. The main entries run north-south with the block entries driven perpendicular to the main entries in an east-west direction. The rooms are then driven perpendicular to the panel entries. This arrangement yields square- and rectangular-shaped pillars for maximum stability. The RH level will dip slightly toward the east (see Drawing 94568-A4).

Except for a minor amount of footage mined with conventional methods by the shaft crews, all openings on the RH level are constructed with the same type mining machine used on the TRU level and with the exception of the shop area, and possibly in the experimental area, are driven two passes wide by one pass high. This results in an ovaloidal shaped opening 10 ft high by ~31.5 ft wide with an available roadway width of 27 ft, which is large enough to accommodate the design canister in the post-WIPP horizontal storage configuration.

Major requirements that dictated the design of the RH level layout are

That the storage and construction operations be separated

That the airstreams used for the storage areas be separated from those used for construction operations

That storage operations progress on a retreating basis toward shaft pillars not only within a panel, but also on the level overall

That thermal loading be less than 75 kW/acre

The quantities of waste to be stored

The resulting layout meets these requirements as follows: the two easternmost main entries are used for waste storage and the two westernmost main entries for construction. The outer two main entries are used as travelways and fresh air intakes while the two inner entries are used to route the exhaust air streams from the working areas to the exhaust ventilation shafts. The primary ventilation flow streams under maximum conditions and the routing of the salt conveying system at its maximum extent are shown on Drawings 94568-A5 and -A6.

Waste receival rates dictated the storage sequence and mining plan included in Drawings 94568-A7 and -A8. The first block mined on the RH level is on the east side of the main entries south of the experimental area. The blocks west of the main entries are mined next with the northernmost block the last one mined. The panel farthest from the main entries in each block is the first mined. Then, the remaining panels are mined in order, retreating toward the main entries.

Electrical Systems. In addition to the same power required on the TRU level. this level requires power for the experimental area. The electrical feeders that run to the TRU level for normal and emergency power also extend to switchgear on the RH level. Transfer switches then distribute power to the various load centers.

Standby power is provided to several of the loads on the RH level. All electric loads underground can tolerate power interruption except for the computer station. Uninterruptible computer power is provided by storage batteries during switchover to standby power. Any of the underground circuits can be supplied from the standby power source; however, only communications, alarms, emergency lighting, and the experimental area are normally connected to the emergency power system. A complete description of the electrical systems is included in Section 4.2 and Drawings 94568-E1 through -E4.

2.4 RH WASTE HANDLING, EMPLACEMENT, AND RETRIEVAL
(See RH Waste Flow Schematic, Fig. II. 2-4-1)

2.4.1 SURFACE FACILITY AND SHAFT

The RH waste package and shipping configurations are defined in Section II. 1. 1. Figure II. 2-4-1-1 shows a normal flow pattern, and Drawings 94540 define all handling areas within the RH surface facility and the handling equipment.

2.4.1.1 Normal Flow--All RH waste shipments are contained in casks transported by rail or truck. The railcar or truck trailer is positioned in the shipping/receiving area, and the following operations occur:

Cask-Handling Sequence

Inspect casks for exterior contamination.

Remove casks from their transport vehicle using the overhead crane and wash those casks that are not radioactively contaminated, but dirty, while they are located on the dock.

Lower the cask into the transfer cell by using the bridge crane. (The transfer cell cover and the cell door are interlocked to provide an airlock.)

Position the cask on a pallet so that the centerline locations of the canisters are known. (A rail cask is positioned directly on the pallet while a truck cask is placed inside a special pallet that may contain as many as four truck casks.)

Remove the bridge crane, close the transfer cell cover, and open the cell door. This allows personnel from the preparation/decontamination area to enter the transfer cell and secure the cask to the pallet.

The cask/pallet transporter moves the cask to one of five cooldown stations in the preparation/decontamination area.

Upon completion of cooldown, prepare the cask for unloading by removing cask accessories, removing all cask head closure nuts not required to guarantee closure through a seismic event, and installing the remotely operated impact wrench head removal fixture and cask seal bag.

The cask/pallet transporter moves the casks into the elevator room and onto the elevator.

The elevator raises the cask/pallet to the unloading position, and the cask seal bag is attached to the port flange.

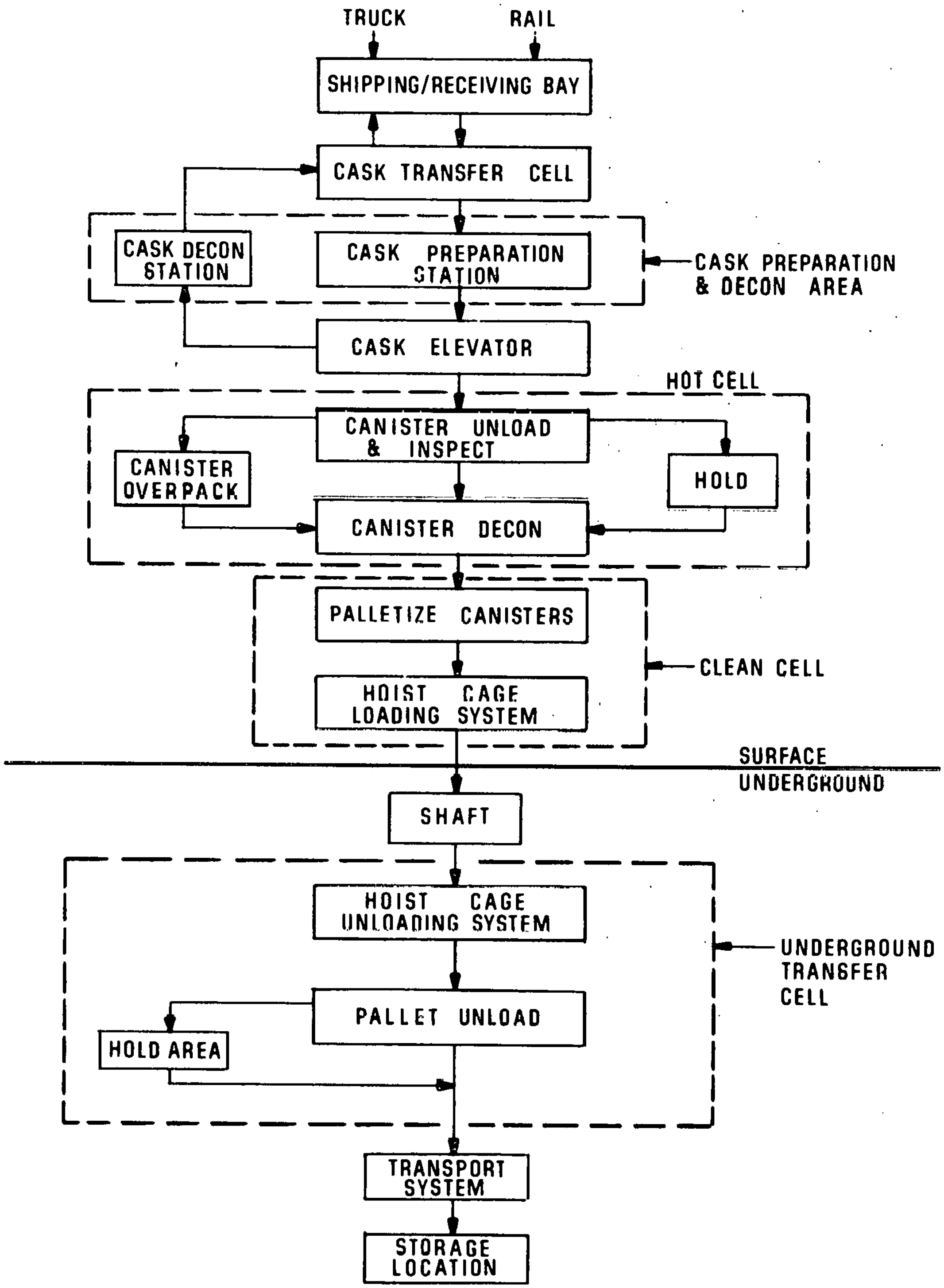


Figure II. 2-4-1. RH waste-handling schematic

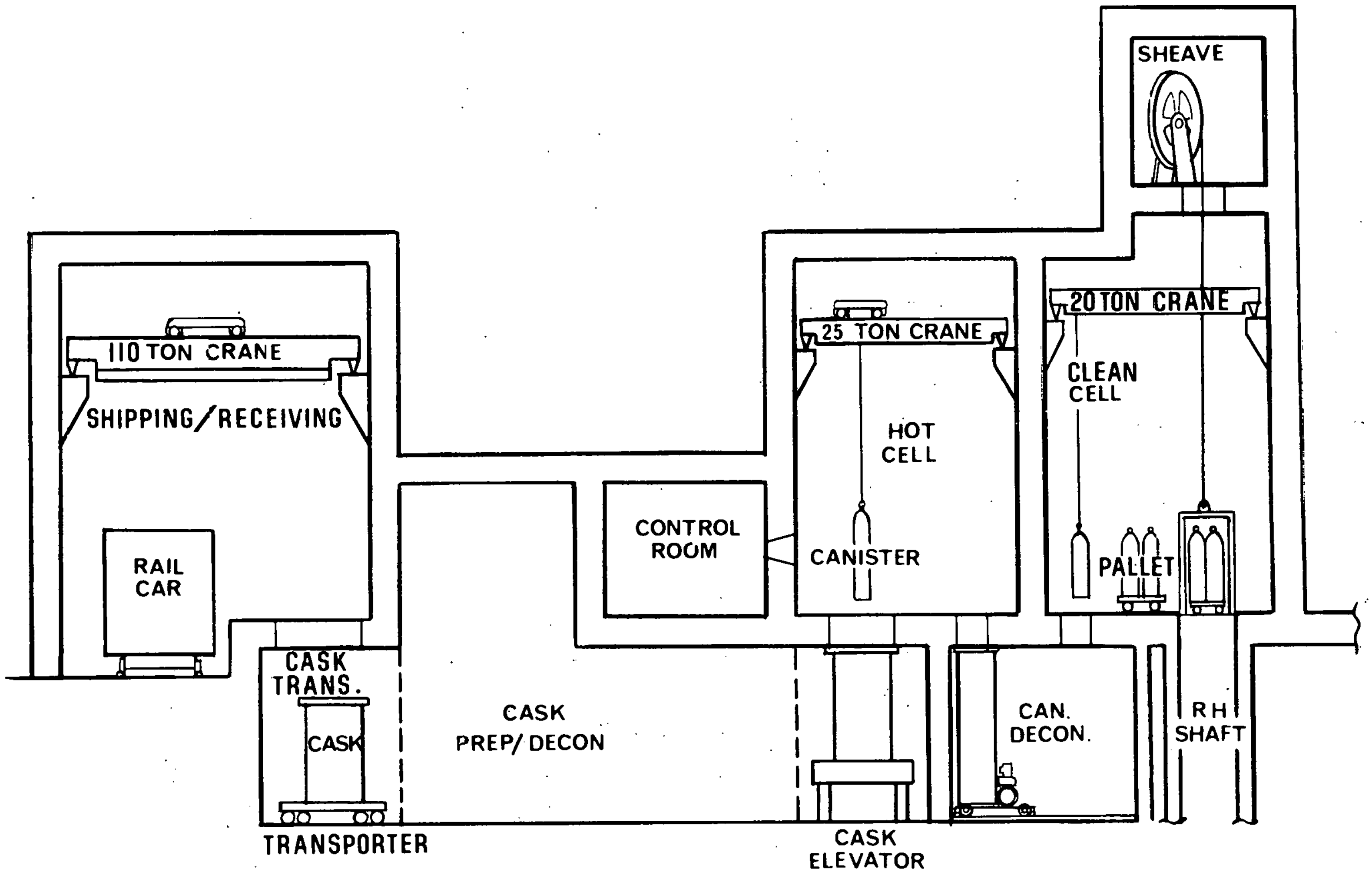


Figure II. 2-4-1-1. Surface RH waste flow diagram

The elevator door is closed and the hot cell port is opened. (The elevator door provides radiation shielding.)

The hot cell remote manipulator engages the cask head removal fixture, and the pneumatic impact tools are actuated to remove the cask hold-down nuts.

The hot cell programmed crane is used to remove the cask head and install the cask shield cover.

After all the canisters are removed from the shipping cask, remove the cask shield cover, install the cask head, and close the hot cell port.

Open the elevator door, disconnect the seal bag from the port flange, and secure the bag to maintain any contamination inside the bag.

Lower the cask/pallet by the elevator and move it by the transporter to the decontamination station in the preparation/ decontamination area.

Decontaminate the top of the cask by wiping, utilizing the hand holes in the seal bag. Remove the seal bag and dispose of it in a radwaste container.

Inspect the outside of the cask for contamination, and reinstall the cask accessories. The transporter moves the cask/pallet into the transfer cell.

The cask is unfastened from the pallet, the transfer cell door is closed, the cell cover is opened and the cask is removed by the crane and placed back on a railcar or truck trailer. The dock may be used for temporary storage.

<u>Canister Handling</u>. These operations start after installing the cask shield over the cask in the hot cell.

Canister-Handling Sequence

Remove canisters one at a time by the programmed crane, and visually inspect each canister for damage and swipe the exterior surface for surface contamination.

Lower the canister into the canister decontamination room by the hoist.

Upon completion of decontamination, move the canister by decontamination vehicle to the clean cell port where it is picked up by the clean cell programmed crane and placed into a multi-canister pallet. (The clean cell and hot cell decontamination ports are interlocked.)

Move the loaded pallet by the clean cell crane and place into the hoist-loading station that loads the RH hoist cage.

Lower the loaded cage to the lower transfer cell where the pallet is rotated out of the shaft conveyance.

Unload the canisters from the pallet by the lower transfer cell crane and move them to holding receptacles under the transfer cell ports.

Should the above sequence of operations be interrupted, there are storage pits to hold eight canisters in the hot cell. (These pits may also be used as a buffer to smooth out the material flow through the hot cell.) Additional hold areas are not provided since the safest and most economical way of storing RH waste is in the shipping cask.

2.4.1.2 Interrupted Flow Conditions--There are several places in the normal flow operations where decisions have to be made to pass or reject the material. The normal flow described above only addresses the acceptable decisions; the following covers the operations required when the material is rejected:

Casks that are contaminated upon receipt are moved from the shipping/receiving area to the preparation/decontamination area and are decontaminated to acceptable limits.

Contaminated empty casks are decontaminated to the permissible transportation level while located in the decontamination station prior to return shipment.

Damaged or excessively contaminated canisters are moved to the overpack and weld station where they are overpacked and inspected. This station is located in the hot cell.

2.4.2 UNDERGROUND PROCEDURES AND EQUIPMENT FOR EMPLACEMENT AND RETRIEVAL OF RH WASTE

2.4.2.1 High-Level Waste--Characteristics of high-level waste that influence underground handling procedures and equipment design are described below.

Radiation. High-level waste is highly radioactive; consequently, handling procedures and facility and equipment designs must assure adequate radiation protection for personnel during all waste-handling operations.

Thermal Power Generation. High-level waste is characterized by a high thermal power output; this characteristic produces unique problems in handling, storage emplacement, and retrieval, namely:

> The high thermal output of the waste requires that equipment designs use high-temperature compatible materials and/or auxiliary cooling systems.
>
> The thermal output of stored high-level waste raises the surface and air temperatures in the storage rooms to levels that necessitate precooling prior to reentry for waste retrieval.
>
> The increased temperatures in the salt resulting from the heat output of the waste will accelerate storage room creep closure; thus, it is necessary periodically to remine the storage rooms to maintain the clearances required for retrieval operations.

2.4.2.2 Experimental Waste Forms--Two forms of high-level waste are used for experimentation in the high-level experimental area of the WIPP; these are:

Canistered Waste. The canisters for experimental high-level waste purposes are similar to commercial waste canisters. One modification is required to these canisters to assure retrievability; this modification requires thickening of the can base to assure its structural competency after long-time exposure to the corrosive environment. Figure II.2-4-2-1 details the high-level waste experimental canister used for equipment and procedure conceptual design.

Noncanistered Waste. Experiments are conducted in the WIPP experimental area using waste that, as emplaced, is not in canisters. This waste is granulated and spans a size range from sand size to 1 in. in diameter. Individual experiments using this waste will probably not exceed 100 liters in volume.

2.4.2.3 Experimental Waste Storage Configurations--The individual storage configurations used for the two forms of experimental waste are detailed in Figs. II.2-4-2-2 and II.2-4-2-3.

2.4.2.4 Equipment Required to Emplace Canistered High-Level Experimental Waste

Drill. This drill is used to drill the emplacement holes for all high-thermal-output experimental waste, and uses, where possible, currently available components tailored into a system designed specifically for drilling precisely oriented holes into salt. Figure II.2-4-2-4 is a conceptual representation of this drill that identifies its major components and lists the currently envisioned design criteria.

Drill Cutting Collector. This item is used with the emplacement hole drill to control the dust generated during hole drilling, to collect the drill cuttings, and to transport the cuttings to the mined salt removal system. The drill cutting collector is shown in Fig. II. 2-4-2-5.

Remotely Handled Waste Transporter. The RH waste transporter is shown in Figs. II. 2-4-2-6 through II. 2-4-2-10. The cask shown on these figures will accommodate a high-level waste canister 15 ft long and 16 in. in diameter filled with three-year-out-of-reactor solidified waste. The running gear of the transporter, exclusive of the main frame (i.e., the suspension, manual and automatic steering, brakes, tires, wheels and drive system) is adapted from commercially available towing and hauling vehicles. The transporter is used for purposes other than canistered high-level experimental waste emplacement; these uses will be described in subsequent sections of this document.

Ancillary Systems. Listed below are additional items that are required to support the emplacement of canistered high-level waste:

- Backfill Salt Crusher and Grading System--A small crushing and screening plant that selectively grades the salt to be used to backfill holes after canisters are emplaced.

- General Purpose Towing Vehicle--Used for moving emplacement hole drill and cutting collector. (Note: This item is identical with the prime mover for the TRU waste straddle lift trailer.)

- Transporter Guidance Wire--This wire is emplaced in slots cut into the floors of the waste storage rooms and carries signals necessary for controlling the automatic steering and positioning system of the high-level waste transporter.

- Guidance Wire Installation Slot Cutter--A commercially available concrete slotting saw adapted for cutting slots in salt.

- High Precision Survey System--Used to locate precisely the as-drilled emplacement holes. This location information is used in conjunction with other techniques to establish the starting point for canister retrieval.

2.4.2.5 Operational Sequence for Storage of Canistered High-Level Waste--The following detailed operational sequence for storage of canistered high-level waste is schematically shown in Fig. II.2-4-2-11.

Sequence to Store Canistered High-Level Waste

Position transporter over underground transfer cell port. This operation commences with the positioning of the transporter in the proper location with respect to the transfer cell port; the positioning of the transporter is facilitated by the use of guide rails and positive stops installed in the roadway over the transfer cell. The second step is to raise the transporter using the transporter jacks to the height required to allow cask rotation. Next, the cask is rotated to the vertical position and the transporter jacks are retracted, allowing the cask to set into the counterbore around the transfer cell port. Note: The counterbore guarantees necessary radiation shielding so that transporter operators can remain in cab.

Lower grapple from cask and attach to canister. This operation starts with opening the shielded closure in the lower end of the transporter cask and the shielded closure on the transfer cell port. After both closures are open, the transporter operator lowers the canister grapple using the transporter hoist until the grapple engages and automatically latches onto the hoisting fitting of the waste canister. Note: The transporter operator is in communication with the cell operators during all canister loading operations.

Hoist canister into cask and close ports. Hoisting a waste canister is done in two stages: the first stage is a short lift to verify that the grapple connection is good. (This lift does not fully remove a canister from its support in the transfer cell.) After the grapple connection is verified, the cell operators signal to continue hoisting. After hoisting is complete, the shielded closures on both the transfer cell and cask are closed.

Rotate cask to horizontal position and raise leveling jacks. Prior to rotating the transporter cask it is necessary to raise the transporter on its jacks to a height sufficient to clear the transfer cell port counterbore. After the cask is in the horizontal transport orientation, the jacks are fully retracted to provide road clearance.

Using manual control, drive to storage room.

Position transporter over guidance strip and switch to automatic guidance control. From this point, the transporter is under the control of automatic guidance system.

Under automatic guidance control, proceed to storage hole. The automatic guidance and control system properly positions the transporter relative to the storage hole so that no additional alignment adjustments, other than leveling the transporter are required before proceeding with canister storage.

Prepare for unloading. Before discussing the preparations required for canister unloading, we point out certain features of the storage holes, namely: 1) the holes are approximately 4 in. larger in diameter than the canister so that slight misalignments between the hole and the transporter cask bore can be accommodated; 2) the hole boring procedures and equipment assure minimum hole deviation from vertical; and 3) the hole collars are counterbored to a diameter sufficient to clear the cask outside diameter to a depth of 6 in. Preparing to unload the canister involves the following steps: 1) the transporter is raised and leveled on its jack system; 2) the cask is rotated into the vertical position; 3) the transporter is lowered until the cask bottoms on the counterbore. (Note: The lowering is done by synchronous use of jacks so that the transporter remains level.)

Lower canister into storage hole. The canister lowering operation is preceded by opening the shielded closure at the lower end of the cask. (Note: When the cask is vertically oriented, the cask closure actuator that is in the main frame of the transporter can be engaged.) The canister is lowered using the transporter hoist until it contacts the bottom of the storage hole. It is then raised off hole bottom by approximately one inch.

Install backfill material. Before discussing the salt backfilling operation, we point out several features of the transporter pertinent to backfill installation. These are: 1) with the cask in the vertical position, the connection to the salt hopper on the transporter is automatically made; 2) the salt from the transporter backfill hopper is mechanically injected into the bore of the cask at a point below the cask closure.

After the suspended canister has stabilized, an amount of salt sufficient to hold the canister in the suspended vertical position is inserted into the hole. The canister is then released by supplying air pressure to the grapple. The grapple is then hoisted back into the cask and the cask closure shut. The remaining backfill is then inserted.

Rotate cask and return to transfer cell.

2.4.2.6 Equipment Required to Retrieve Canistered Experimental High-Level Waste

Shielded Manifold. This item serves as the foundation for the retrieval cask and drill system; additionally, it provides the cutting removal air outlet to which the salt cutting collectors attach. This item is shown and further described in Fig. II. 2-4-2-13.

Drill Cutting Collector. This item is described in Section 2.4.2.4 and shown in Fig. II. 2-4-2-5.

Contaminated Drill Cutting Collector. The contaminated drill cuttings collector collects, controls, and packages drill cuttings generated during canister retrieval that are potentially radioactive. Additionally, it provides the air quantities necessary for cuttings removal. This item, along with a description of its features pertinent to control of radioactive particulate in the drill cuttings stream, is shown in Fig. II. 2-4-2-20.

Retrieval Cask and Drill System. This basic tool used to retrieve canistered high-level experimental waste consists primarily of three components: 1) a shielded cask; 2) a drill drive and feed system; and 3) a two-stage drill system comprised of an expanding hole drill and a core barrel. This item is shown in Fig. II. 2-4-2-12. The operational use of this item is shown in Figs. II. 2-4-2-13 through II. 2-4-2-18. The operation of this equipment is discussed in Section 2.4.2.7.

RH Waste Transporter. The high-level waste transporter described in Section 2.4.2.4 is the prime mover and hydraulic power source for the retrieval cask and drill system.

2.4.2.7 Operational Sequence to Retrive Canistered High-Level Waste

Preretrieval Preparation. Depending upon conditions existing at the retrieval site, all or part of the following listed tasks must be performed before starting retrieval.

Preretrieval Sequence

Ventilate drift for time sufficient to bring air and surface temperatures down to personnel and machinery tolerance levels.

Remine drift to dimensions required to clear retrieval hardware. Remining should result in smooth and level floor.

Measure retrieval area radiation background to establish time limits for personnel occupancy and/or establish the need for shielding mats.

Using precision survey and other techniques, locate canister retrieval start point.

Core drill to determine depth to radioactive salt and to verify canister location.

Sequence to Retrieve Canistered High-Level Waste

Grout and bolt shielded manifold. (Note: This operation and subsequent operations are shown schematically in Fig. II. 2-4-2-19.) The shielded manifold must be leveled and precisely aligned with the projected canister centerline. After leveling and aligning, the manifold is grouted and rock-bolted to the floor to prevent shifting. The installed manifold is shown in Fig. II. 2-4-2-13.

Mate retrieval cask to shielded manifold. The retrieval cask and its included drill system is carried by the high-level waste transporter to the retrieval location. At the retrieval location, the transporter is properly positioned, then raised on its jacks to allow cask rotation. After the cask is rotated to the vertical position, the transporter is lowered until the cask mates with and is fully supported by the shielded manifold.

Prepare for retrieval drilling. The preparation involves the following: 1) the installation of the drill operator's platform around the top of the retrieval cask; 2) the installation of the drill drive system; 3) the connection of the drill drive system to the hydraulic power source on the transporter; and 4) the connection of the drill dust and cutting collector to the shield manifold and the air inlet fitting at the top of the drill drive system.

Drill to top of canister. This drilling is done using the first stage of the retrieval drill. The first stage, by use of an automatically expanding drill head, bores a hole of sufficient diameter to clear the core barrel used for overcoring the waste canister. The cuttings generated during the drilling operation are continuously monitored for radiation. If cuttings show radioactive material content, the drilling operation is stopped until the drill cutting collector is removed and replaced with the contaminated drill cutting collector. This operation is shown in detail in Fig. II. 2-4-2-14.

Overcore canister. The first step in the overcoring operation is to attach the drill drive system to the core barrel. This is done by raising the first stage drill into the core barrel, with cutters retracted, until it bottoms and then rotating the drill shaft until the threaded connection between the first stage drill head and the core barrel is fully made. See Fig. II. 2-4-2-15. After this connection is made, the core barrel is lowered on the drill shaft to the bottom of the hole previously drilled by the first stage drill. Overcoring is then started and proceeds to a depth approximately 6 in. beyond the bottom end of the canister. When this depth is reached, the core barrel downward progress is stopped and rotation is continued until the canister undercutting latches have undercut the canister and are in the latched position. These operations are illustrated in Figs. II. 2-4-2-16 and II. 2-4-2-17.

Several items must be noted to support the overcoring process. They are: 1) the core barrel inside diameter is oversized to the canister by approximately 4 in.; 2) the drill string is supported only at the top of the retrieval cask during the overcoring drilling. This provides flexibility in the drill string so that the core barrel can follow a canted canister; and 3) the working of the canister latches on the end of the core barrel is dependent on a nonsolidifying material in the initial fill of the canister emplacement hole (see Fig. II. 2-4-2-2).

Raise canister into retrieval cask. By using the drill string and drill hoisting system, the core barrel and contained canister are raised into the retrieval cask and secured by clamping the drill string. The shielded closure on the base of the retrieval cask is then shut (see Fig. II. 2-4-2-18 for details). Note: The extra-thick canister base specified in Fig. II. 2-4-2-1 assures that the contents of the canister are contained during hoisting.

Backfill hole with clean salt (see Fig. II. 2-4-2-18). This operation is optional. If hole backfilling is required, salt is inserted using the salt injection system of the transporter in the same manner used for backfilling holes after canister emplacement.

Rotate cask and return to transfer cell. This operation is preceded by the removal of the drilling system and the installation of the shielding cap over the drill stem penetration at the top end of the retrieval cask.

Lower core barrel with canister into confinement container in transfer cell. The detailed steps required to accomplish this task are:

In the transfer cell, install the confinement container onto elevating dolly and position under cell port.

Raise container until it mates with underside of cell port.

Outside of cell, position transporter. Rotate cask and mate with cell port.

Remove shielding cap over drill stem penetration on cask.

Install hoisting fitting in the end of drill stem.

Attach overhead cell service hoist to hoisting fitting using pneumatic grapple.

Apply tension to hoist cable.

Unlock drill stem.

Open shielded closures on cask and cell port.

Lower core barrel with waste canister into confinement container.

Close shielded closure on cell port.

After the outlined steps are completed, the confinement container is lowered and moved to position for installing a mechanical closure.

2.4.2.8 Equipment Needed to Emplace Uncanistered High-Level Experimental Waste

Equipment	Figure Nos.	Description and Function
Equipment	II. 2-4-2-4	The same drill system used to drill holes for canistered waste, except that an overreaming cutter and a taper reamer are provided for this operation.
Emplacement Cask	II. 2-4-2-21 II. 2-4-2-22	A shielded cask with mechanisms to safely control emplacement of granular waste. The cask is mounted on a preinstalled plate with the valves within the cask positioned to the "closed" position. The main features of the cask include: Filler hole and plug Shielding closure Filler sleeve, rack- and pinion-actuated Release valve, rack- and pinion-actuated Top shield plug Figure II. 2-4-2-22 shows the shielding closure, the filler sleeve and release valve positioned to release the waste.

Equipment	Figure Nos.	Description and Function
Drill Cutting Collector	II. 2-4-2-5	The salt collector is the same one used for canistered waste-hole drilling.
Cask Trailer	II. 2-4-2-23	A special trailer to transport the emplacement cask from the transfer cell to the prepared hole. The trailer is provided with hydraulic jacks to lower the cask onto the mounting plate.
Small Hole Drill		A commercially available drill used to drill the experimental sampling hole.

2.4.2.9 Operational Sequence for Storing Uncanistered High-Level Waste--

Mine drift and hole dimensions shown in Fig. II. 2-4-2-3 are the result of calculations that assure restoration of lithostatic pressure in the area of the waste material as soon as possible after placement. All operations illustrated in Fig. II. 2-4-2-3 except the installation of the waste and grout are completed prior to the placement of the waste material and include:

Pre-Emplacement Sequence

Drill a 6-in.-diameter hole 30 ft deep

Overream bottom 5 ft of hole to 13-in. diameter

Ream 6-in.-diameter hole to 8-in. for salt plug

Ream top 4 ft of hole to 9-in. diameter for sleeve

Drill 3-in.-diameter sample hole on an angle to top of overreamed hole

Connect valve to sample tube

Install sleeve and mounting plate on waste-fill hole

The sequence of events shown in Fig. II. 2-4-2-24 illustrates the use of the equipment previously described.

Sequence for Storing Uncanistered High-Level Waste

Place the cask under the port of the transfer cell and open the cellport.

Hoist the cask out of the transfer cell by the overhead hoist and lower it into the trailer.

Tow the trailer to the storage hole by the utility tug and position it over the hole. Use the jacks on the trailer to lower the cask to a mating position on the mounting plate.

Open the shielding closure, lower the filler sleeve, raise the release valve, and release the waste material from the cask.

When the cask is emptied of waste, raise the filler sleeve, shut the shielded closure, and remove the top plug.

Place 3-ft-long, 8-in.-diameter salt plug into the cask; then open the shielded closure and lower the salt plug until it bottoms.

Since the radiation from the hole has been lowered to a tolerable level by insertion of the salt plug, close the cask and return it to the transfer cell.

Lower a hose into the hole to the top of the salt plug and pump grouting material through the hose, slowly raising it until the hole fills.

2.4.2.10 Equipment Required to Retrieve Uncanistered High-Level Waste--

Much of the equipment used for canistered waste retrieval is used for this operation, including the RH transporter, drill, the shielded cask, the drill drive and feed system, and the contaminated drill-cutting collector. A shielded manifold and closure system is required (Fig. II.2-4-2-26). Figures II.2-4-2-25 through II.2-4-2-27 show the drill can assembly, which is also required and has the special features described below.

The main barrel attaches to the drill pipe at the top and has serrated cutters on the bottom. The periphery of the auger is welded to the inside of the bottom of the main barrel. There are two valves inside the barrel that are closed by turning the pipe (shown inside the main barrel) from the top of the cask. This pipe also provides the path for high-velocity air stream to move the salt chips upward through the top of the barrel and manifold into the salt collector. The inside diameter of the barrel cutters is approximately 6 in. larger than the hole containing the waste material to allow for some misalignment of the retrieval system relative to the waste hole. Figures II. 2-4-2-25 and II. 2-4-2-27 illustrate the valve positions and the pins that assure that the valve remains open until the waste material is inside the barrel.

2.4.2.11 Operational Sequence to Retrieve Uncanistered High-Level Waste--

This operational sequence is illustrated in Fig. II. 2-4-2-28. Retrieval of uncanistered waste requires extensive drift and site preparation before actual retrieval operation. The drift that was originally 10 ft by 10 ft has to be opened to a minimum of 15 ft by 20 ft to allow access for the retrieval equipment. The mine floor is machined flat and level and ventilation air volume established to decrease temperature to an acceptable level. The exact location of the waste is determined from core sample holes. The 4-ft sleeve originally installed for placement is removed, and the shielded manifold and closure, Fig. II. 2-4-2-26, is grouted and bolted to the mine floor.

Sequence to Retrieve Uncanistered High-Level Waste

Position and level the drill (ref. Fig. II. 2-4-2-4), attach the drill-cutting collector, and establish air circulation.

Drill a hole with the same diameter as the outside diameter of the drill can barrel to a depth equal to the length of the drill can.

Remove the drill, position the RH transport, and rotate and lower the shielded cask to mate with the shielded manifold and closure.

Reestablish air flow and lower the drill can to the depth of the hole previously drilled.

The rotating auger cuts the salt and forces the powdered salt up through the lower valve plate (Fig. II. 2-4-2-26) into the airstream. The salt is carried by the airstream out of the top of the drill can through the manifold into the drill cutting collector.

When contaminated salt is reached, turn the air off as the drill continues to turn. Salt and waste material are then pushed into the barrel of the drill can where they remain.

When the drill reaches a level below the waste material (Fig. II. 2-4-2-26), the drill stops rotating. Close the valves inside the drill by rotating the air supply tube that captures contaminated salt and waste removed in the barrel of the drill can.

Hoist the can into the cask and close the shielded closure.

When this operation is complete, pump the clean salt into the hole, if the level of contamination in the area where the waste material is removed permits. This completes the operation.

If, however, more salt must be removed from the area that contained waste material, close the shielded manifold valve, rotate the cask to horizontal on the RH transporter and take the cask to the transfer cell.

Position the RH drill over the hole and overream the hole to move the contaminated salt into the shielded salt collector. After completing this operation, backfill the hole with clean salt.

2.4.2.12 ERDA Intermediate-Level TRU Waste--Characteristics of ERDA Intermediate-Level Waste (ILW) that influence underground handling procedures, equipment design, and storage configurations are described below.

Radiation. The level of radiation output for ILW is of a magnitude that requires significant shielding to protect personnel during all handling operations.

Thermal Power Generation. ILW produces a low thermal output that allows storage in close pack configurations if the integrated thermal output of the waste stack does not exceed that which would raise the temperature in the salt to an excessive level.

2.4.2.13 Storage Configurations--Three storage configurations are used at the WIPP for storage of ILW. These configurations are identified and described as follows:

Experimental Storage Configuration. Used for ILW experimentation within the experimental area of the RH waste storage portion of the WIPP. For this configuration, the ILW must be in canisters scaled to duplicate the high-level waste experimental canister described in Fig. II. 2-4-2-1. Emplacement of experimental ILW is identical to that used for canistered high-level experimental waste (see Fig. II. 2-4-2-2).

WIPP Storage Configuration. Used for ILW during the pilot phase of the WIPP as shown in Fig. II. 2-4-2-29. This configuration assures retrievability; it is not efficient or cost effective if retrieval is not required. Therefore, it is advantageous to limit the quantities of ILW to be stored before successful completion of the pilot plant experimental program and the subsequent deletion of retrieval requirements. Figure II. 2-4-2-29 depicts the design base ILW canister and the items that must be added to make it compatible with the WIPP storage configuration.

Post-WIPP Storage Configuration. Will not be used until retrievability is no longer a consideration; i.e., until experiments have proved that bedded salt is a satisfactory medium for disposal of this waste category. This configuration takes advantage of the low thermal output of ILW by using a high storage packing density. It is shown conceptually in Fig. II.2-4-2-30.

2.4.2.14 Equipment and Procedures for Emplacement and Retrieval of Experimental ILW--

The equipment items and procedures required to emplace and retrieve experimental ILW are the same as those previously described for canistered high-level experimental waste. (See Sections 2.4.2.4, 2.4.2.5, 2.4.2.6 and 2.4.2.7.)

2.4.2.15 Equipment Requirements for Storage of ILW in the WIPP Configuration--

The only equipment used for ILW in this configuration not previously mentioned is a special transport cask. This cask is internally configured to accept the ready-to-store ILW canister shown in Fig. II.2-4-2-29. Exterior dimensions of this cask allow it to be installed on and used with the RH transporter.

2.4.2.16 Operational Sequence for Storage and Retrieval of ILW in the WIPP Configuration--

ILW Storage Sequence, WIPP Configuration

In the transfer cell, place the hoisting adapter extender onto the ILW canister; then install shielding disk. Move the canister assembly into loading position under the transfer cell port.

Using the RH transporter, position and mate the ILW cask to the transfer cell port.

Open closures on cask and cell port, then lower cask hoist to make grapple connection with hoisting adapter extender.

Raise canister into cask and shut closures.

Transport to storage location.

Position cask over storage hole and prepare to unload.

Lower canister into storage hole until the canister bottoms and the shield plate are supported by hole liner.

Release and retract grapple.

To retrieve this waste, reverse the installation operational sequence.

2.4.2.17 Equipment and Storage Preparations for Storing ILW in the Post-WIPP Configuration--

Special Transporter Cask. As shown in Fig. II. 2-4-2-30, post-WIPP storage of ILW uses two-tier horizontal stacking. This requires a transporter cask to be devised that loads canisters vertically at the underground transfer cell and unloads canisters horizontally at the storage location. This special cask is shown in Fig. II. 2-4-2-31. This cask is carried by the RH transporter.

Shielded Unloading Room. This room is the transition station between the transporter cask and the waste stacking dolly (described subsequently). It is a five-sided shielding structure; the open side is inset into the waste storage room as shown in Fig. II. 2-4-2-32. This figure also shows the other support items that are part of the room. Principal items are the stacking dolly chain winch, the monorail termination, the shielded waste insertion port, and viewing windows. This room is portable so that it can be moved to another storage room after each room is completed and backfilled with salt.

Monorail and Trolley System. Used for multiple purposes:

- To carry a remotely operated TV camera into the storage room for viewing the storage operation

- To support and provide for repositioning of the radio antenna used for functional control of the stacking dolly

- To install the salt lines for room backfilling

See Fig. II. 2-4-2-32 for installation of this system.

Stacking Dolly. The stacking dolly is shown in Fig. II. 2-4-2-32, and its functions in Fig. II. 2-4-2-33. The only functional control on the dolly is a solenoid-operated dumping latch that is powered only for unlatching; relatching is automatic. Unlatching is triggered by radio control. Power for the radio control circuitry and the latch is supplied by batteries mounted on the dolly.

2.4.2.18 Operational Sequence for Storage of ILW in the Post-WIPP Configuration--

This operation duplicates previously described canistered waste-handling sequences until the transporter reaches the storage location. At this point the operations are as follows:

ILW Storage Sequence, Post-WIPP Configuration

The transporter, with the special ILW cask horizontal, is mated to the shielded waste insertion port of the unloading room.

The cask closure and the insertion port closures are opened.

The ejection system of the cask pushes the canister through the port, where the canister is picked up by the overhead hoist. The hoist moves the canister over and lowers it onto the stacking dolly.

The insertion port is closed to allow the transporter to return to the underground transfer cell.

The chain winch moves the stacking dolly forward to the waste stack (monitored by remote television).

The unloading latch is released and the canister rolls into the waste stack.

The stacking dolly is pulled back to the unloading room.

These operations are summarized in Fig. II.2-4-2-32.

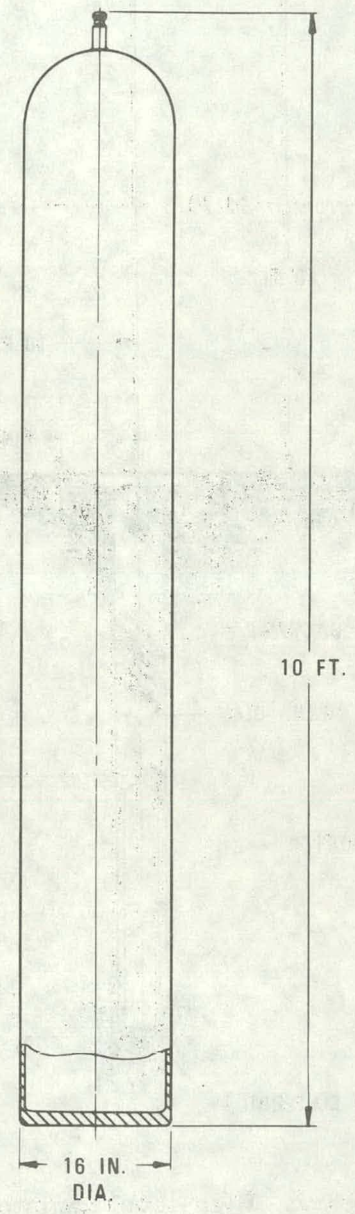


Figure II. 2-4-2-1. High-level waste experimental canister

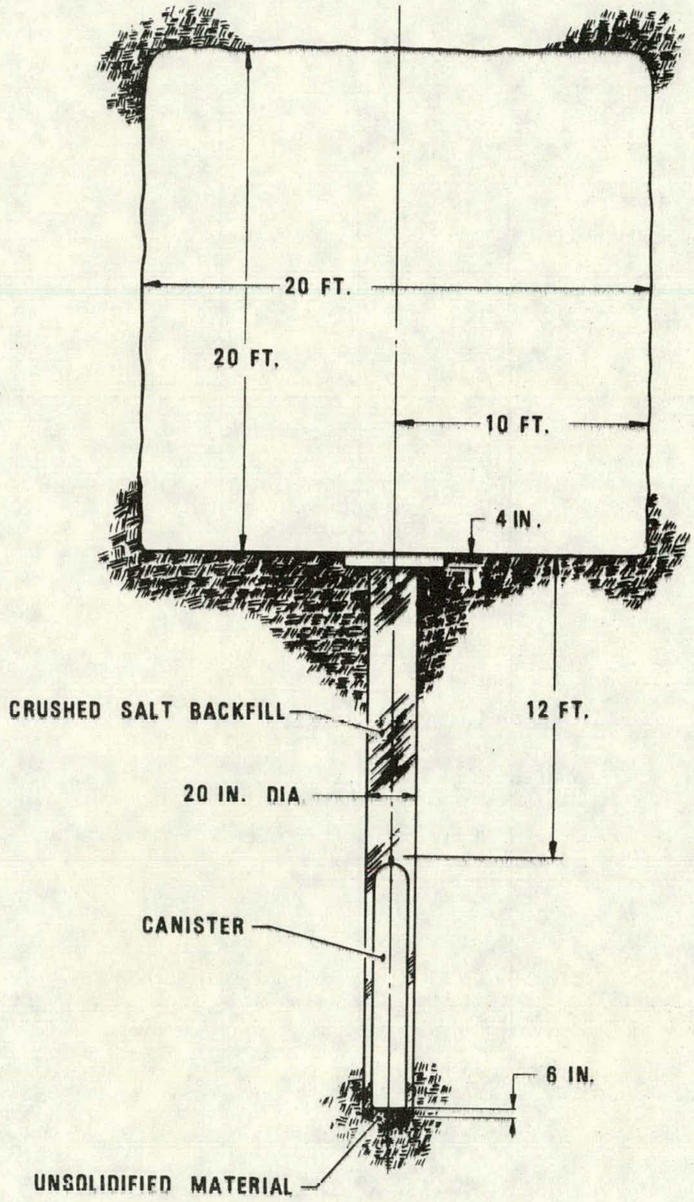


Figure II. 2-4-2-2. High-level canistered experimental waste storage configuration

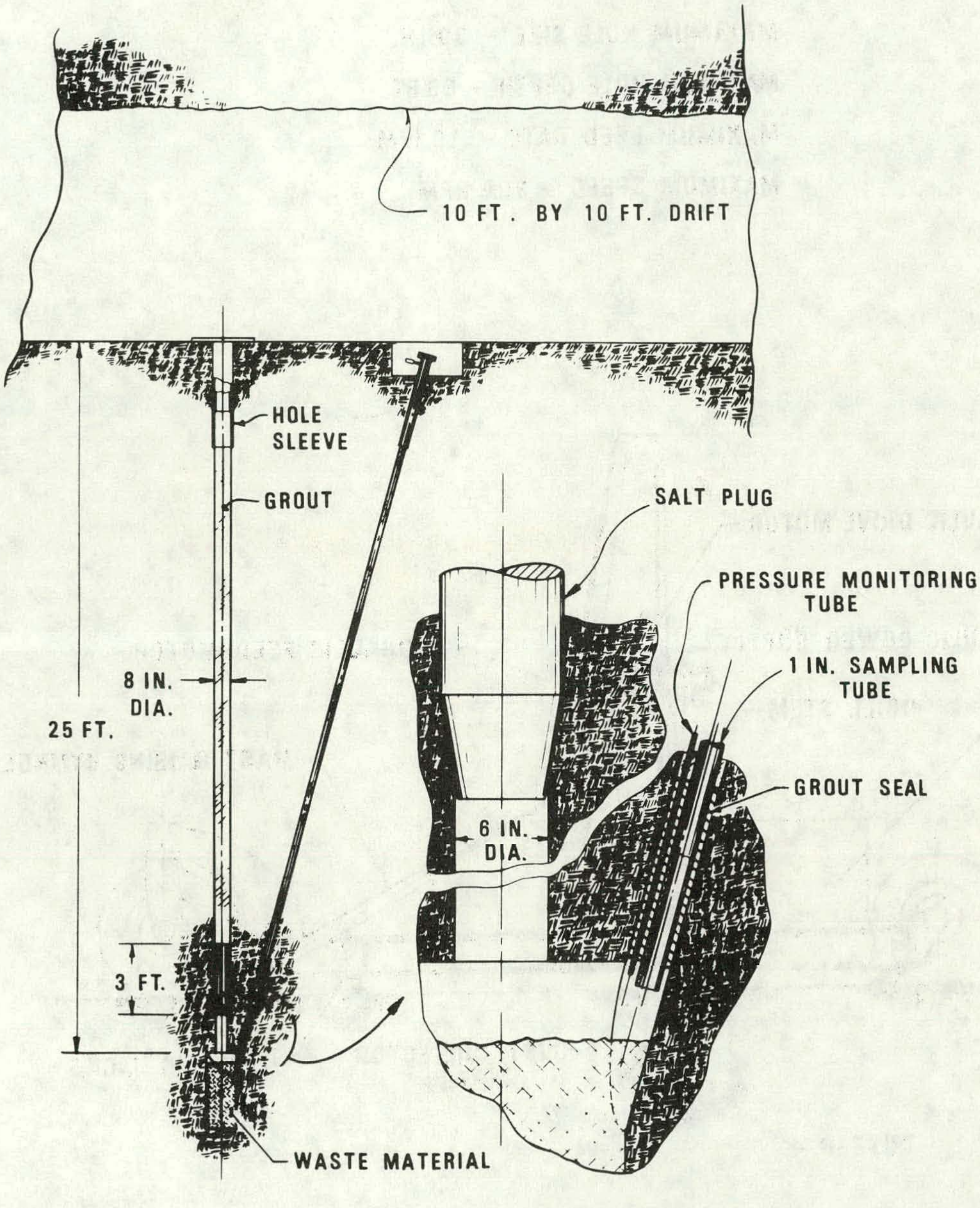


Figure II. 2-4-2-3. High-level uncanistered experimental waste storage configuration

MAXIMUM HOLE SIZE - 30 IN.

MAXIMUM HOLE DEPTH - 50 FT.

MAXIMUM FEED RATE - 10 IPM

MAXIMUM SPEED - 300 RPM

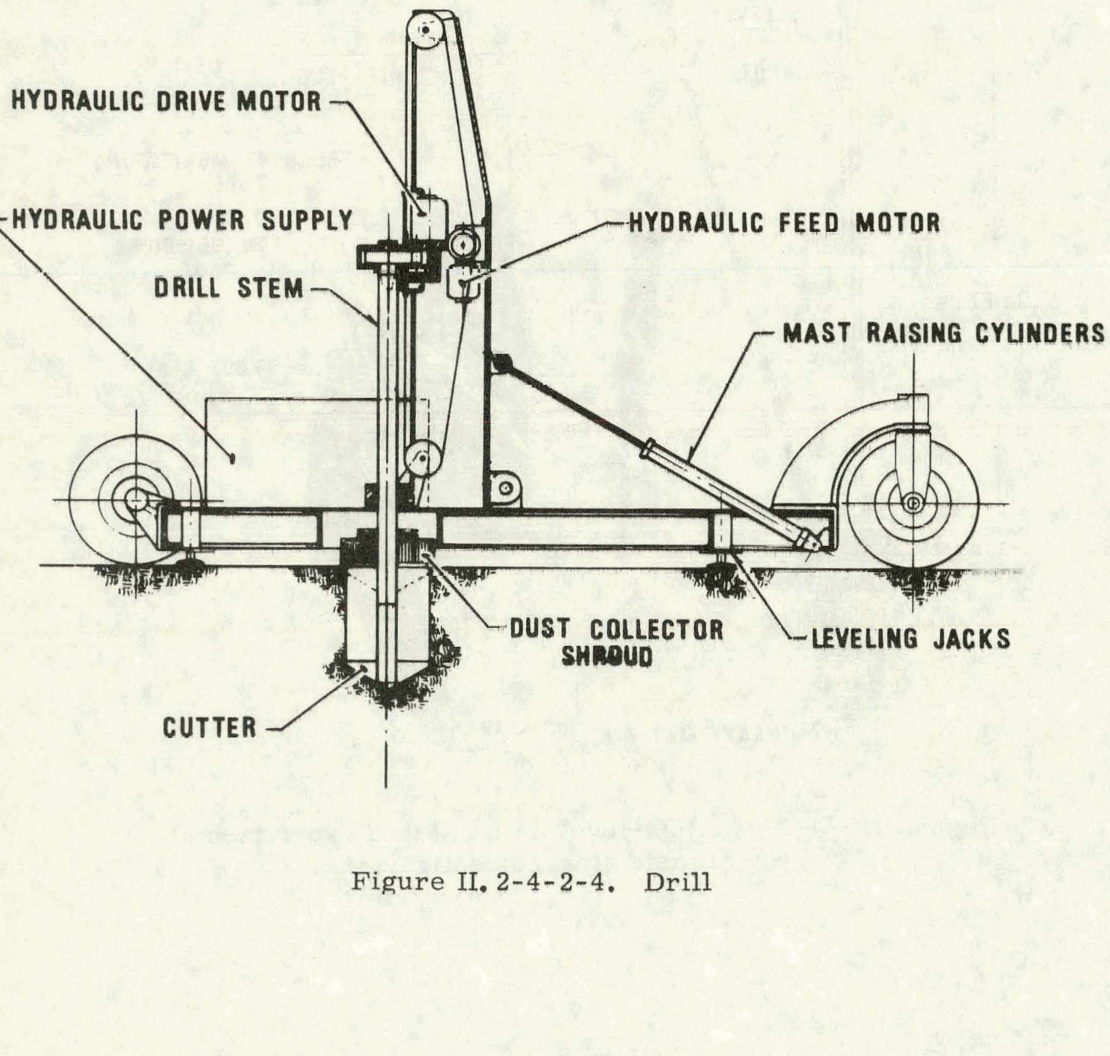


Figure II. 2-4-2-4. Drill

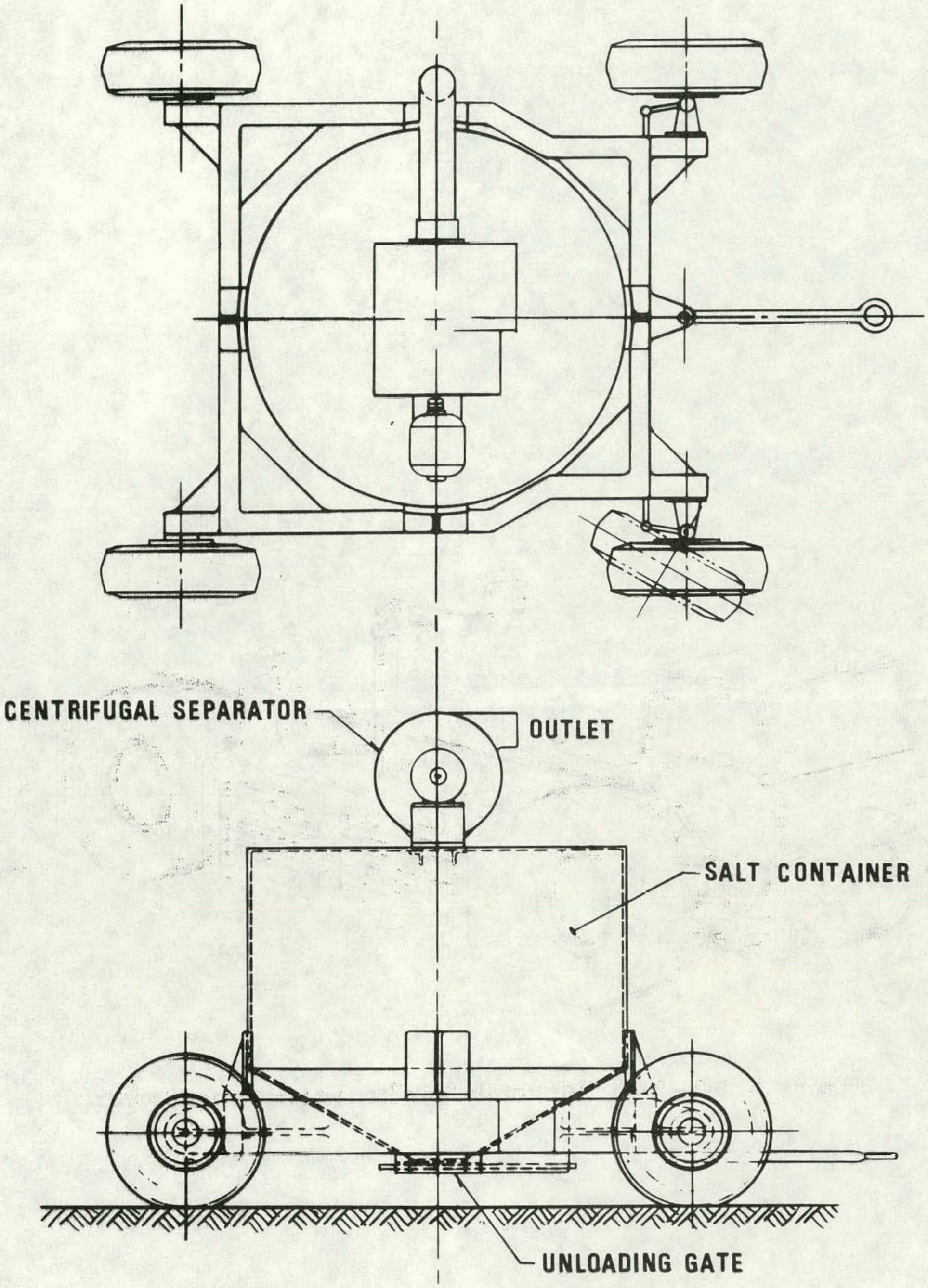


Figure II. 2-4-2-5. Drill cutting collector

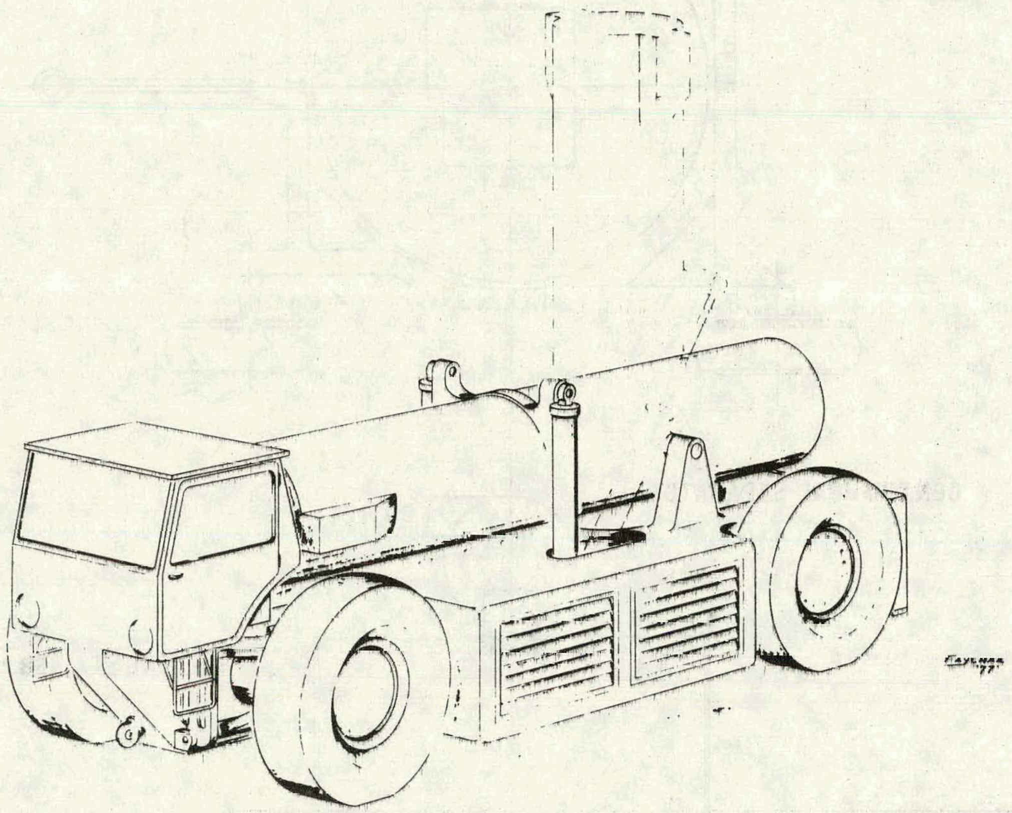


Figure II. 2-4-2-6. Remotely handled waste transporter

1. SIZE AND WEIGHT
   - LENGTH = 25'
   - WIDTH = 10'
   - HEIGHT (CASK HORIZONTAL) = 7' 8"
   - HEIGHT (CASK VERTICAL) = 19'
   - WEIGHT = 110,000 LBS.
2. SUSPENSION AND DRIVE SYSTEM
   - DRIVE SYSTEM IS COMPOSED OF 2 EACH WHEEL MOUNTED D.C. TORQUE MOTORS WHICH DRIVE THE FRONT WHEELS THRU HUB MOUNTED PLANETARY GEAR REDUCTIONS. D.C. POWER IS PROVIDED BY A 180 HORSEPOWER DIESEL ENGINE DRIVEN D.C. GENERATOR.
   - WHEEL BASE = 16' 6"
   - MAXIMUM TRACTIVE EFFORT = 15,000 LBS. (REPRESENTS 11.5% GRADE CAPABILITY)
   - MAXIMUM SPEED = 10 MPH
   - SUSPENSION SYSTEM DESIGN LOAD CAPACITY = 155,000 LBS.
   - ROLLING RESISTANCE = 1000 LBS. (SMOOTH SURFACE)
   - FOUR-WHEEL BRAKING (AIR/OIL ACTUATED)
   - TIRE SIZE 18" X 25" X 46 PLY RATING
   - REAR NON-DRIVEN WHEELS ARE RIGIDLY MOUNTED
   - FRONT DRIVE WHEELS ARE KING PIN MOUNTED ON FRAMES WHICH ARE CUSHIONED ON RUBBER COMPRESSION PADS TO DAMP OUT SHOCK AND ELIMINATE FRAME TWIST.
3. STEERING
   - TRANSPORTER WILL UTILIZE FULL-TIME POWER STEERING
   - STEERING WILL BE PROVIDED ON FRONT AXLE ONLY
   - TURNING RADIUS = 35'
   - TWO STEERING MODES WILL BE PROVIDED. THESE ARE:
     MANUAL - FOR GENERAL MANEUVERING
     AUTOMATIC - FOR POSITIONING OF TRANSPORTER FOR LOADING AND UNLOADING OF CANISTERS. AUTOMATIC SYSTEM WILL BE CAPABLE OF POSITIONING TRANSPORTER WITHIN 1" OF DESIRED LOCATION.
4. CASK
   - MAXIMUM PAYLOAD SIZE = 16" DIA. X 15' LONG
   - EXTERIOR SURFACE DOSE RATE ON LOADED CASK WILL NOT EXCEED 10 MREM/HR.
   - CANISTER HOIST CAPACITY = 10,000 LBS.
5. OPERATOR'S CAB
   - THE OPERATOR'S CAB WILL HAVE TWO OPERATOR STATIONS. EACH WILL HAVE A FULL COMPLEMENT OF CONTROLS AND INSTRUMENTS.
   - CAB WILL BE DESIGNED TO LIMIT OPERATOR DOSE RATE TO 1/2 MREM/HR.
   - CAB INTERIOR ATMOSPHERE WILL BE MAINTAINED AT A POSITIVE PRESSURE WITH RESPECT TO OPERATING ENVIRONMENT. INLET VENTILATION AIR TO CAB WILL BE FILTERED THRU HEPA FILTERS.
6. MISCELLANEOUS
   - TRANSPORTER WILL CONTAIN A BACKFILL MATERIAL RESERVOIR CAPABLE OF HOLDING 20 $FT.^3$ OF BACKFILL MATERIAL.

Figure II. 2-4-2-7. Transporter description

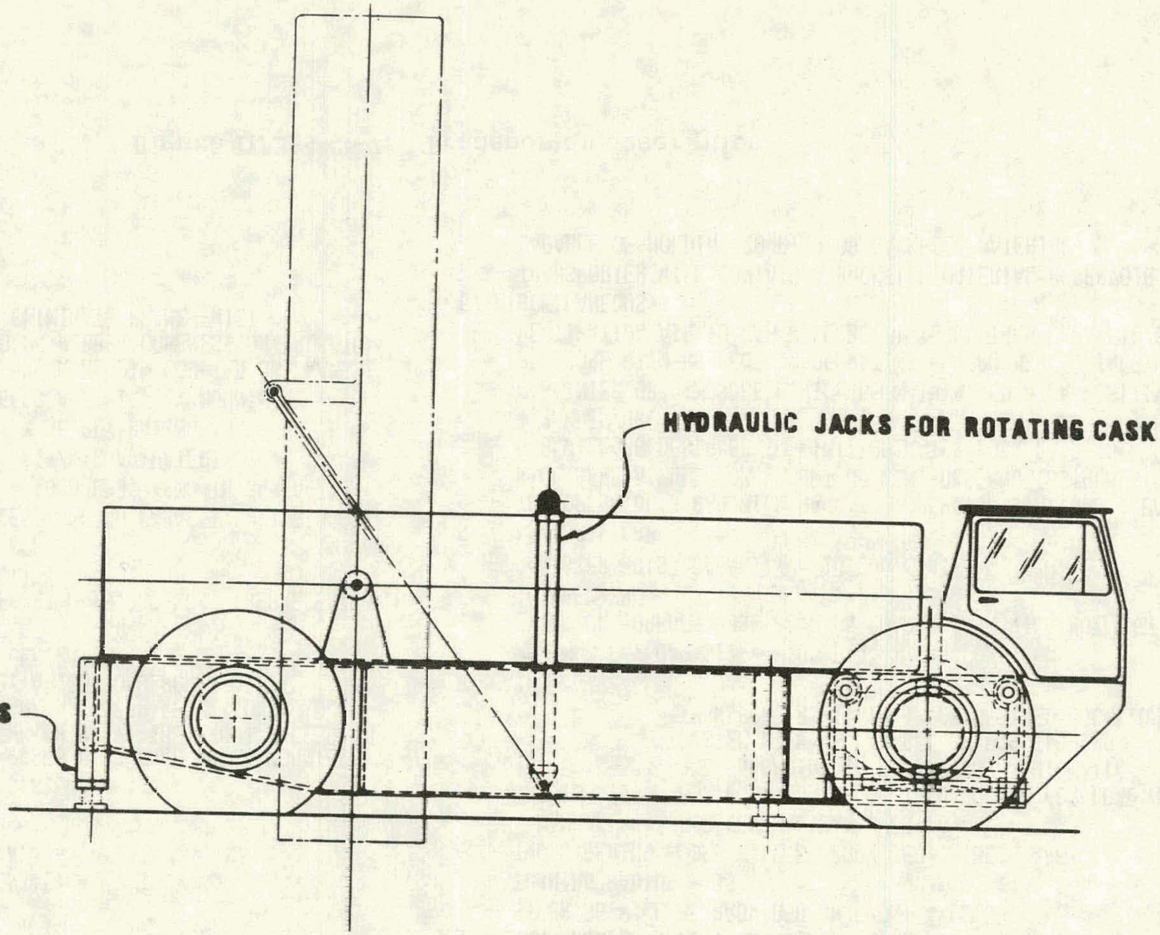


Figure II. 2-4-2-8.   RH transpcrter

[redacted] [redacted]

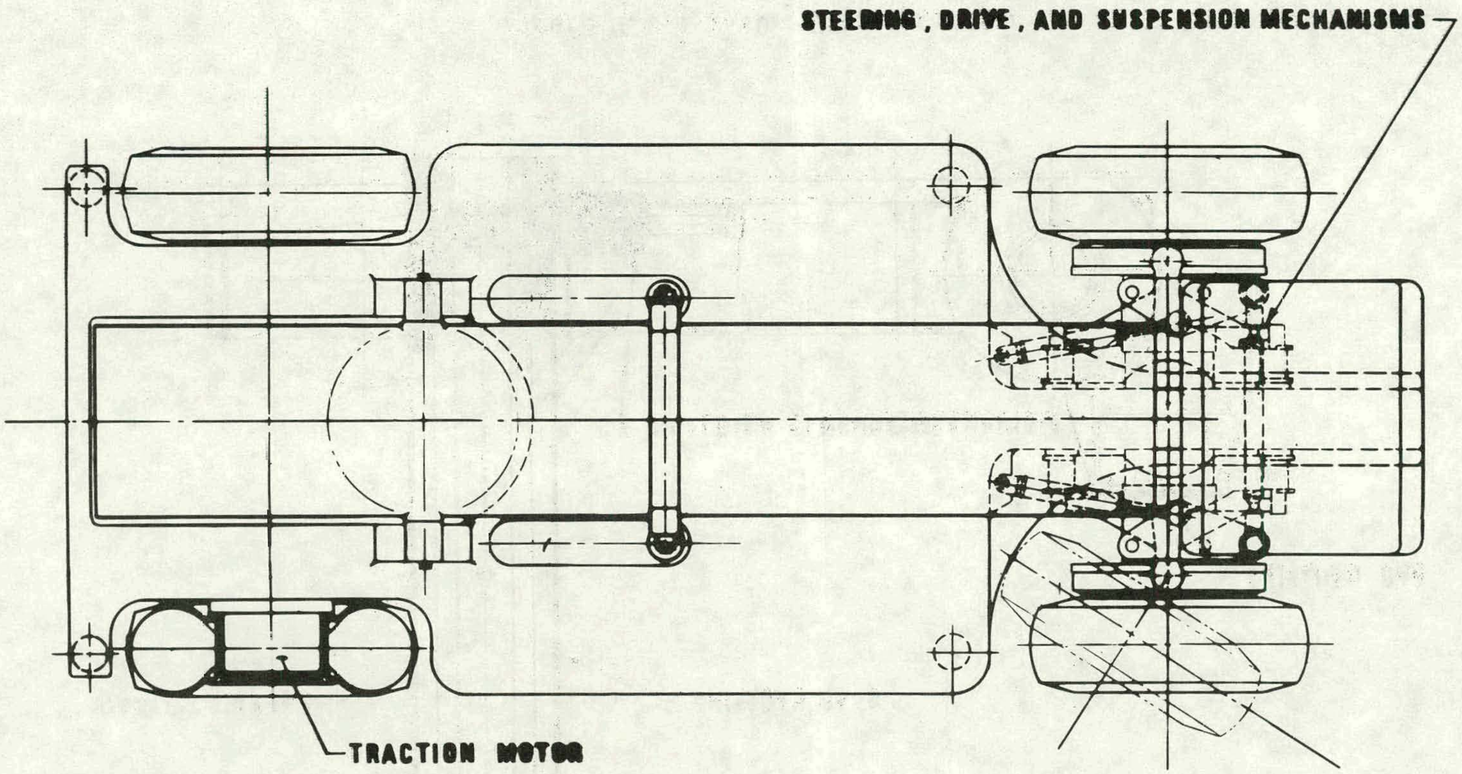


Figure II. 2-4-2-9. RH transporter

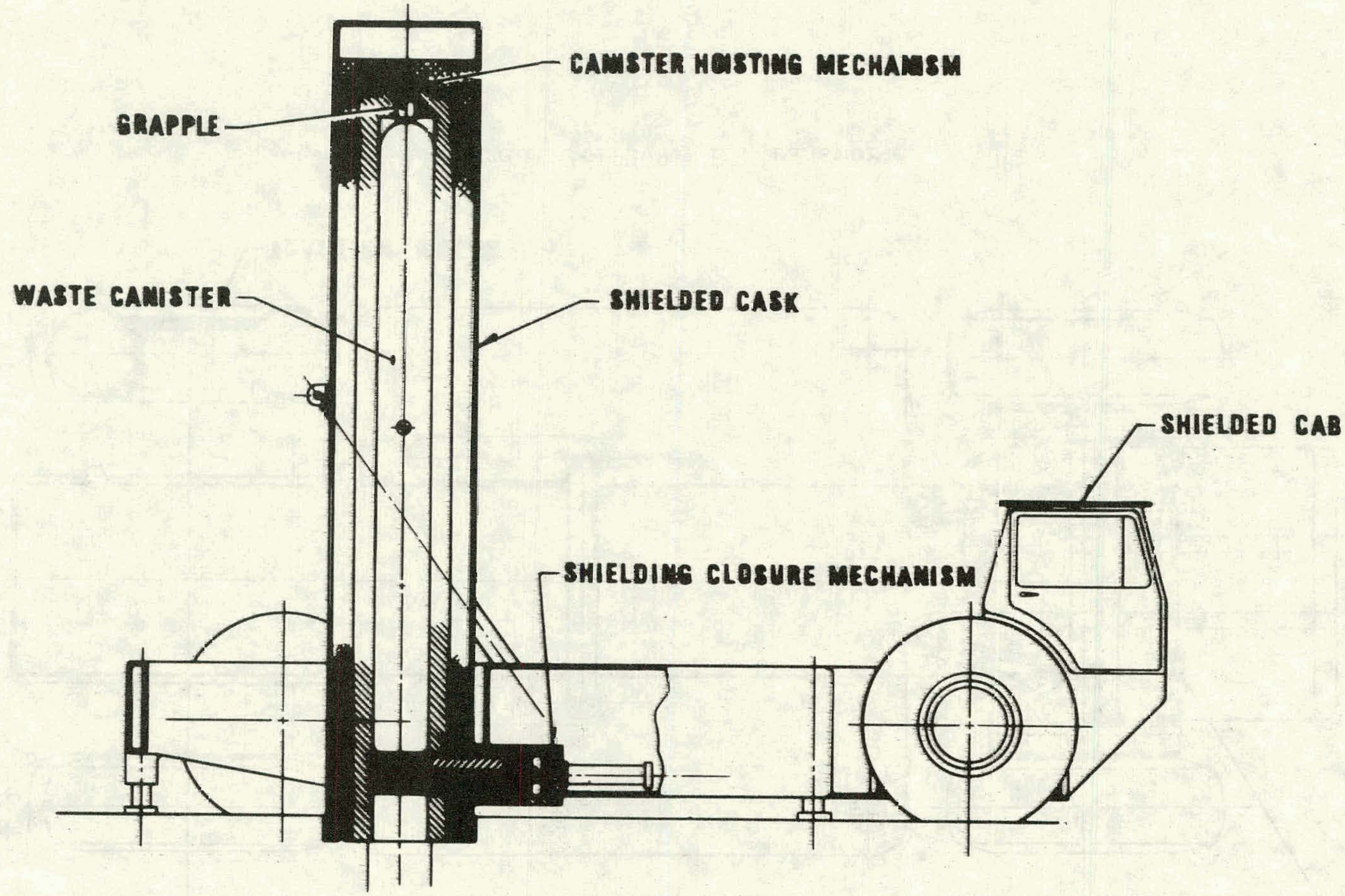


Figure II. 2-4-2-10. RH transporter
(cask cutaway)

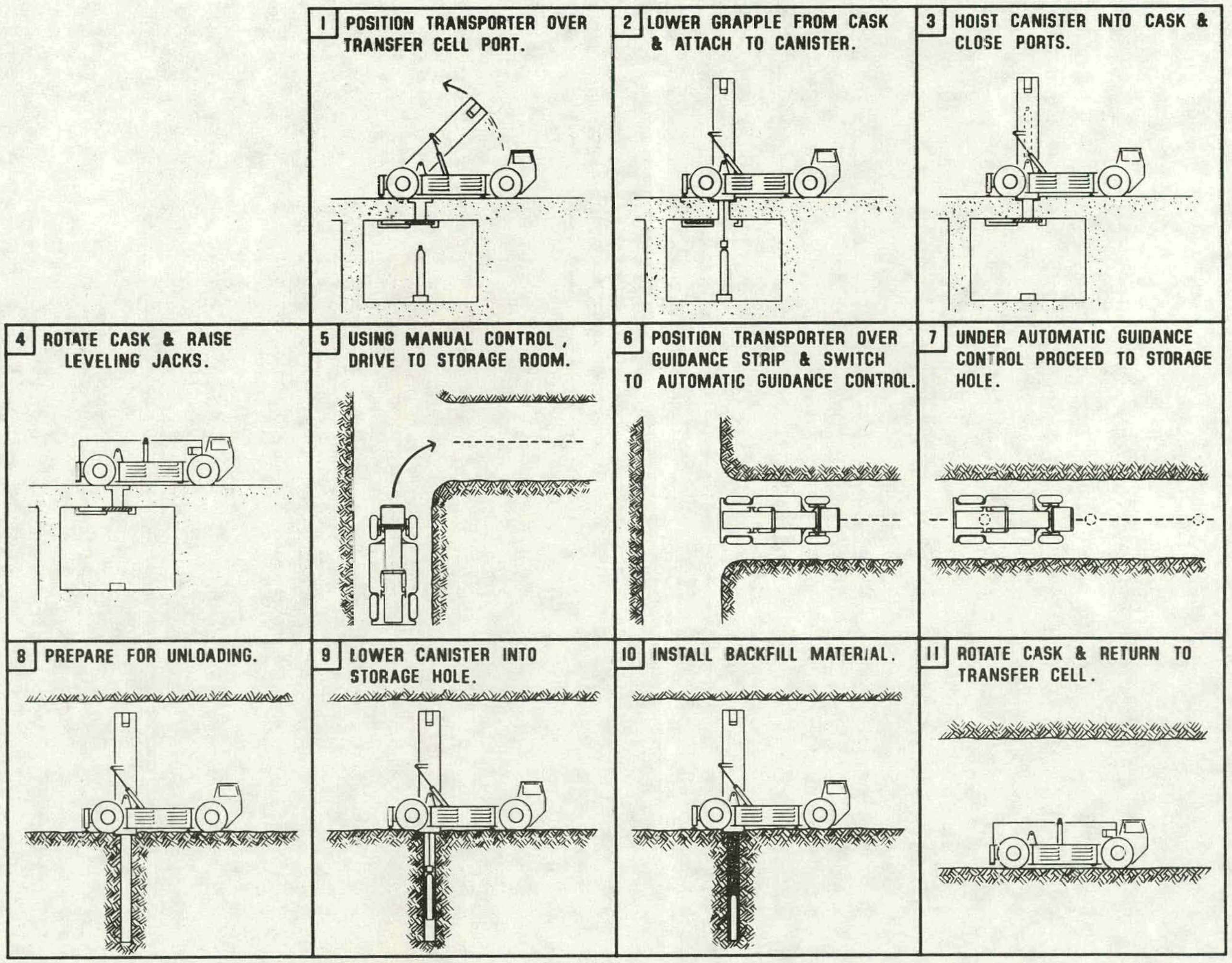


Figure II. 2-4-2-11. WIPP experimental high-level waste canister storage sequence

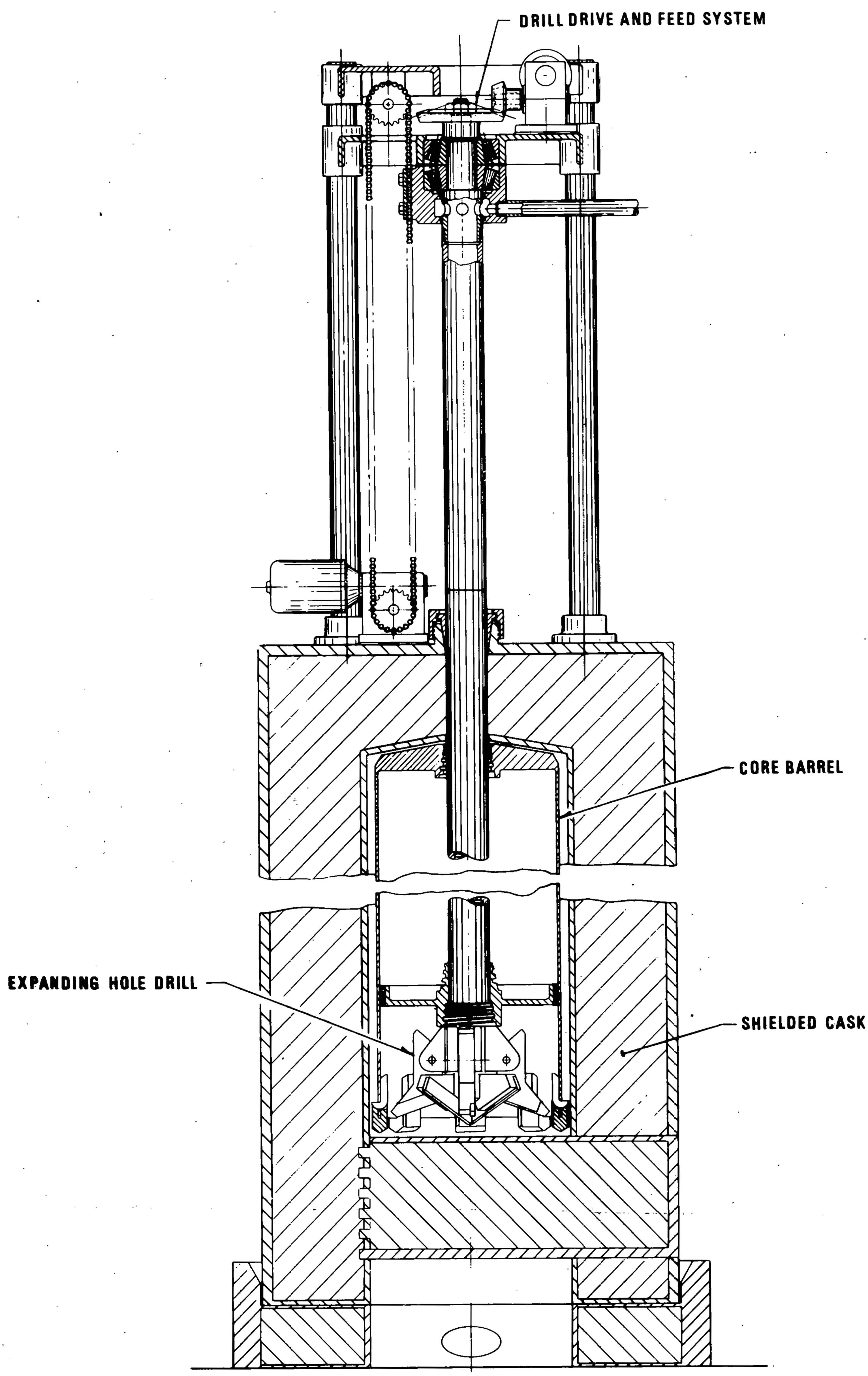


Figure II. 2-4-2-12. Retrieval cask and drill system

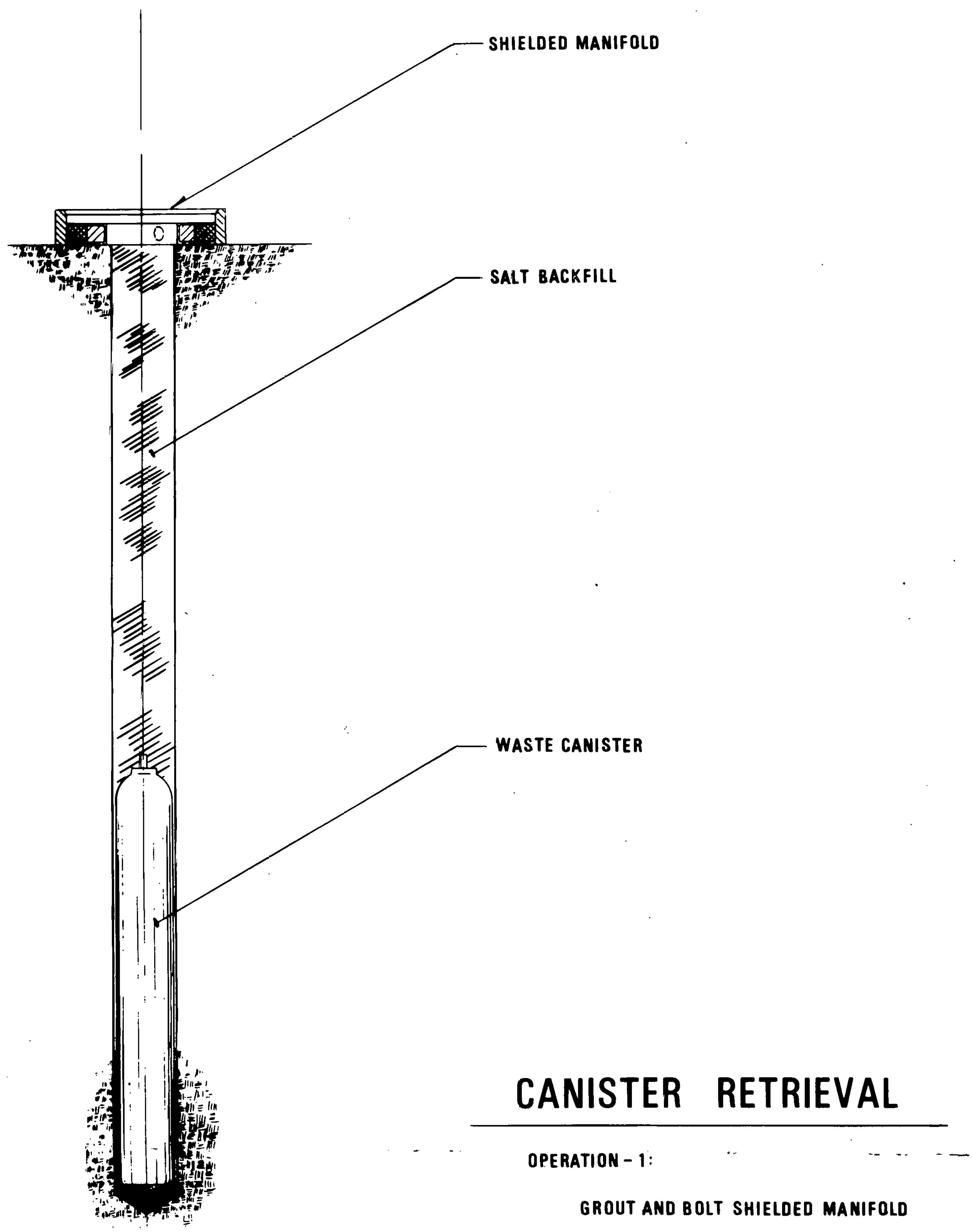


Figure II. 2-4-2-13.

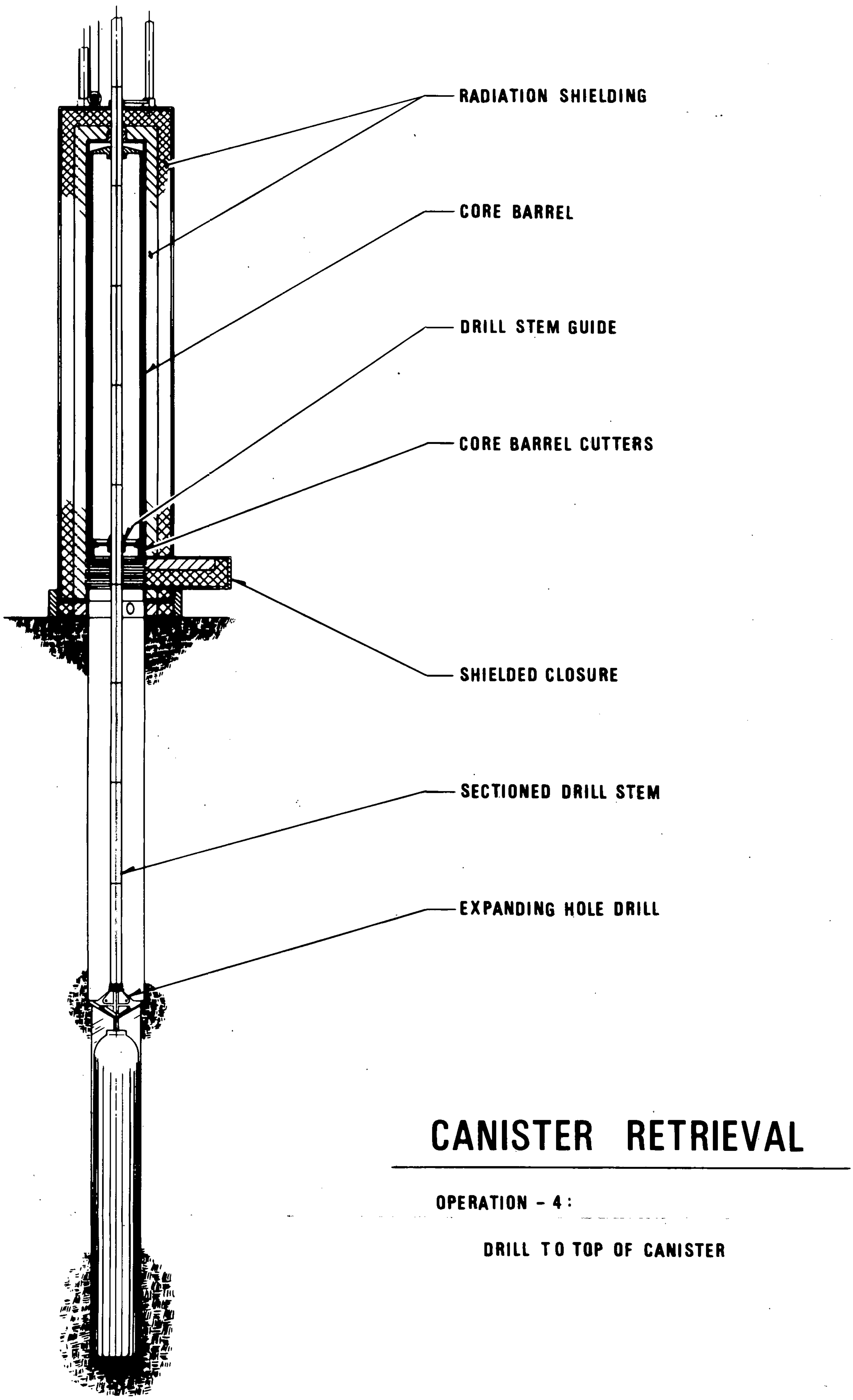
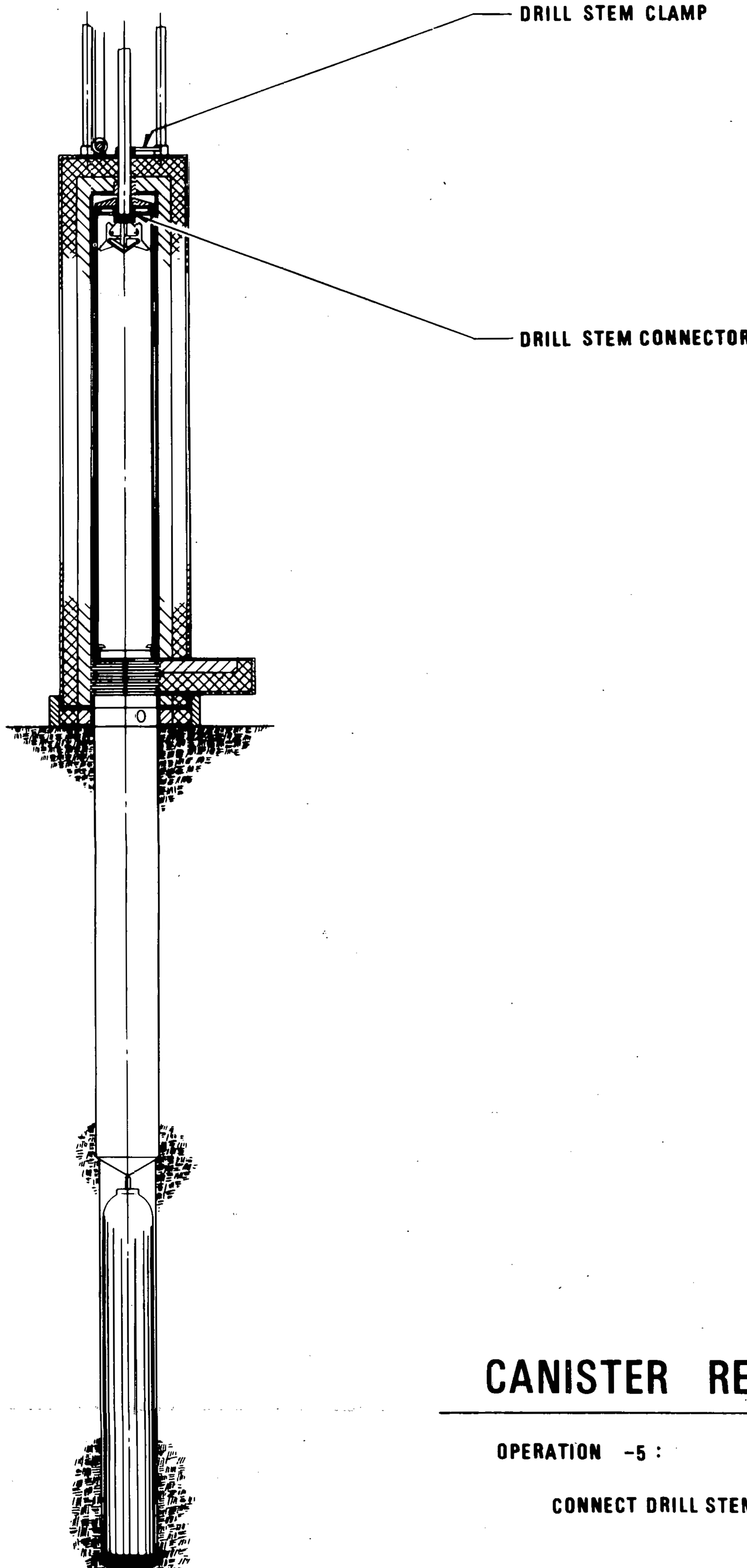


Figure II. 2-4-2-14.

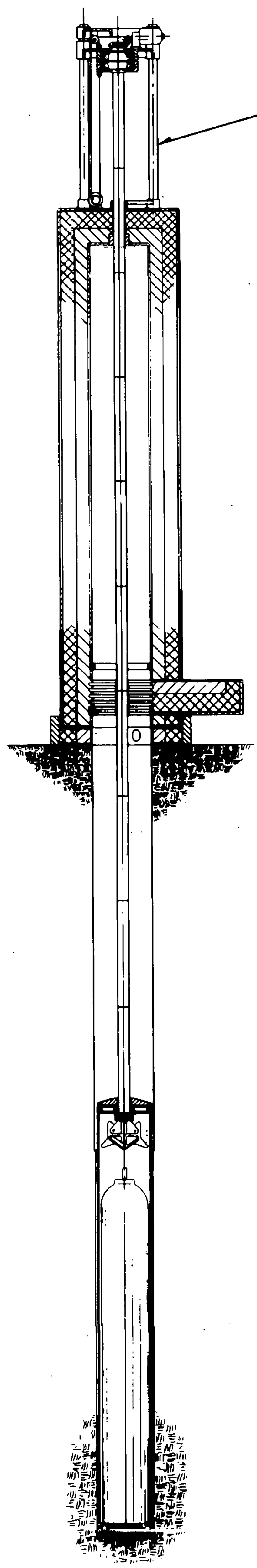


CANISTER RETRIEVAL

OPERATION -5 :

CONNECT DRILL STEM DRIVE TO CORE BARREL

Figure II. 2-4-2-15.

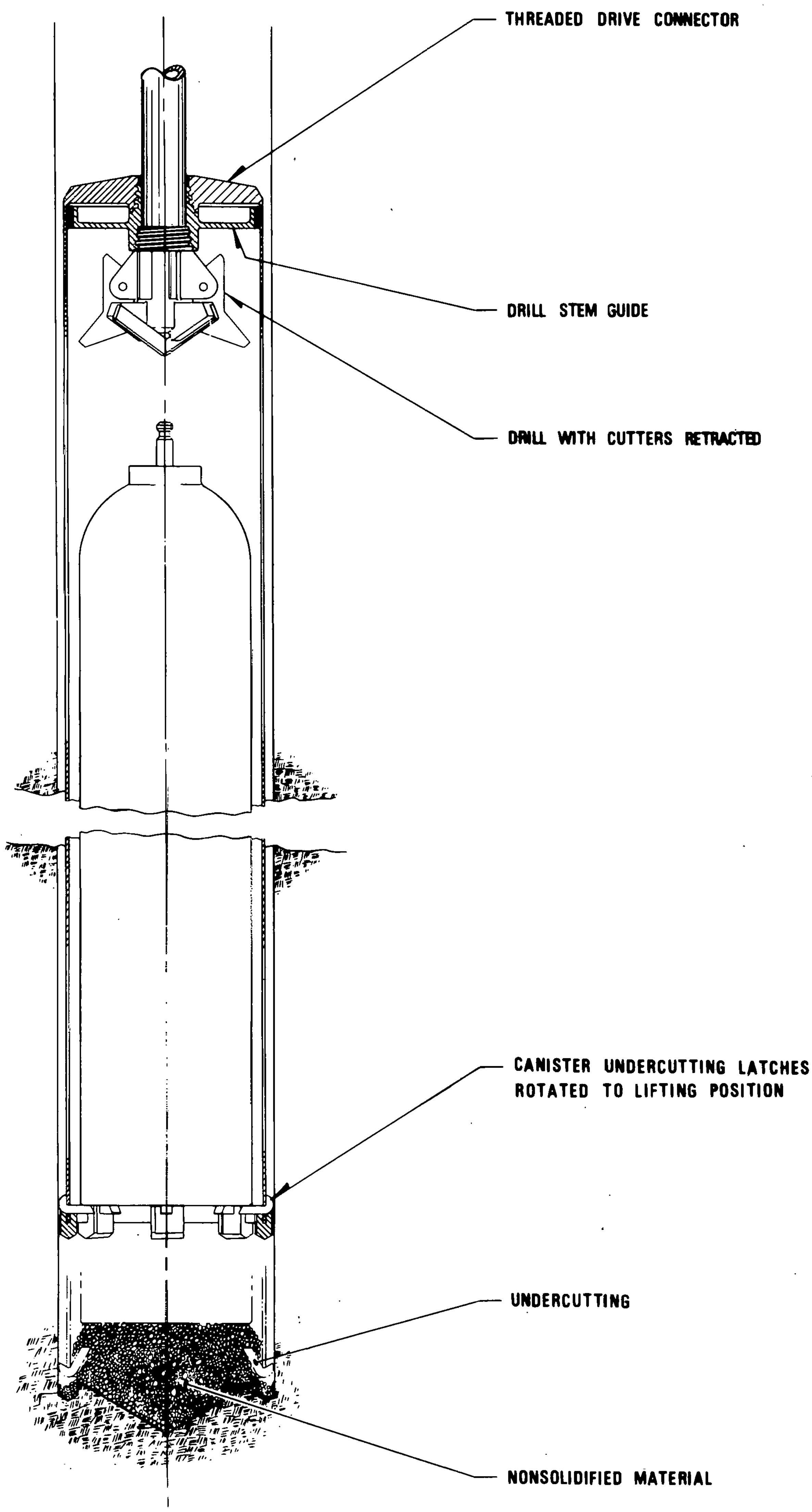


CANISTER RETRIEVAL

OPERATION - 5:

OVERCORE CANISTER

Figure II. 2-4-2-16.

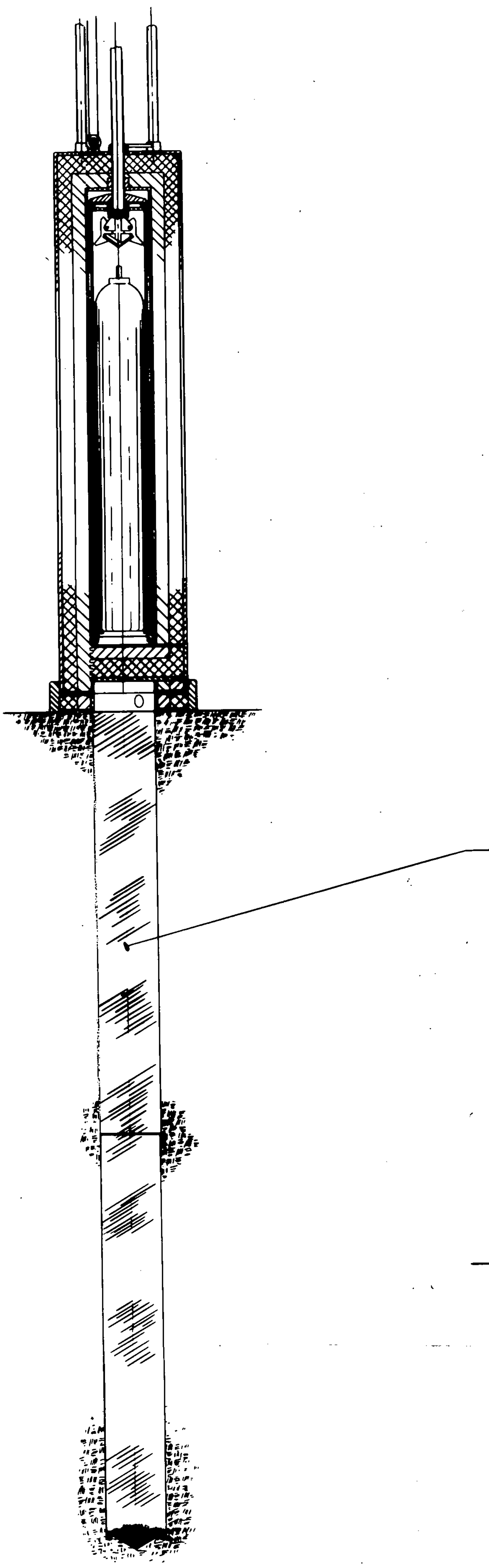


CANISTER RETRIEVAL

OPERATION - 5:

SECURE CANISTER IN OVERCORE BARREL

Figure II. 2-4-2-17.



CANISTER RETRIEVAL

OPERATION – 6:

HOIST CORE BARREL INTO CASK CLOSE SHIELDED CLOSURE BACKFILL HOLE WITH CLEAN SALT

Figure II. 2-4-2-18.

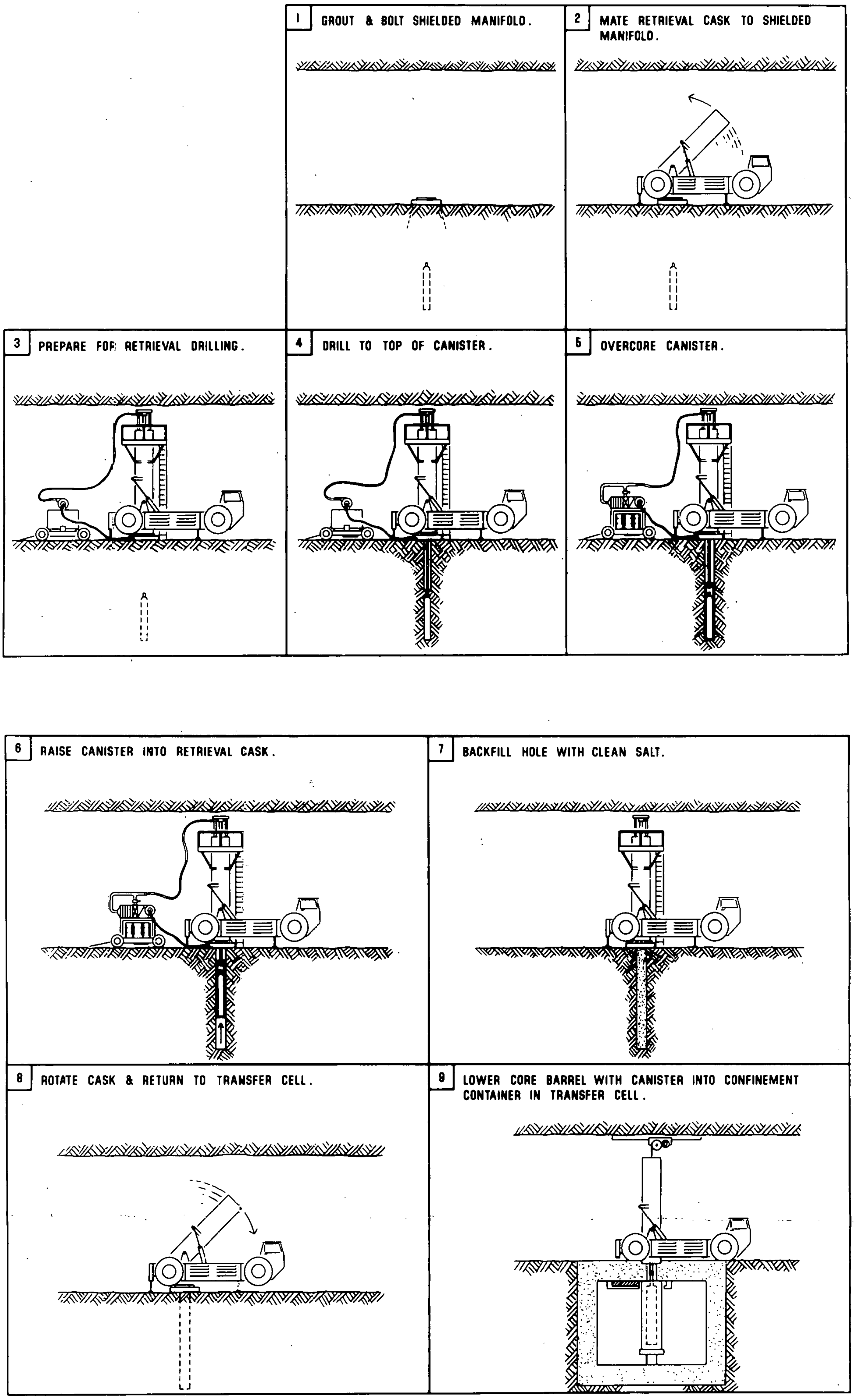


Figure II. 2-4-2-19. WIPP experimental high-level waste canister retrieval sequence

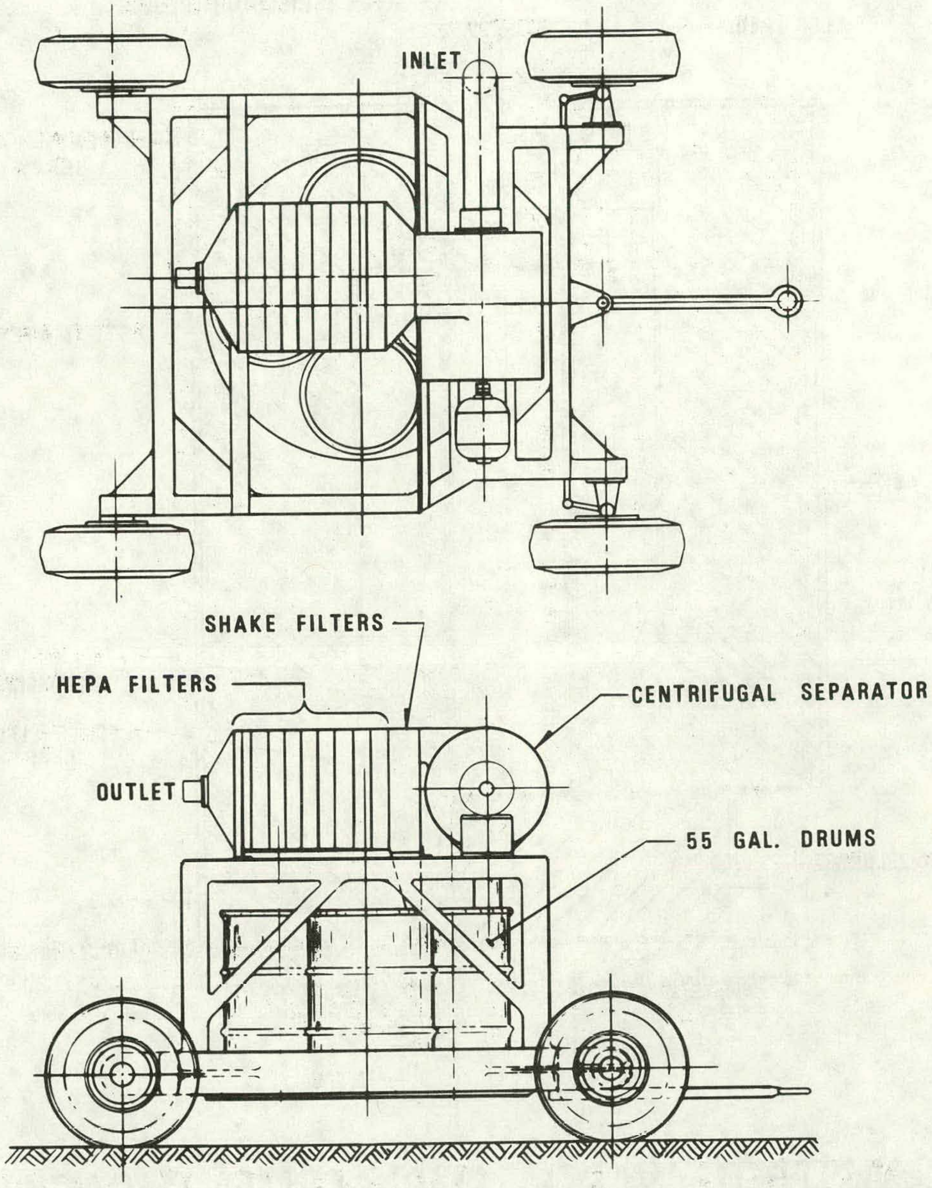
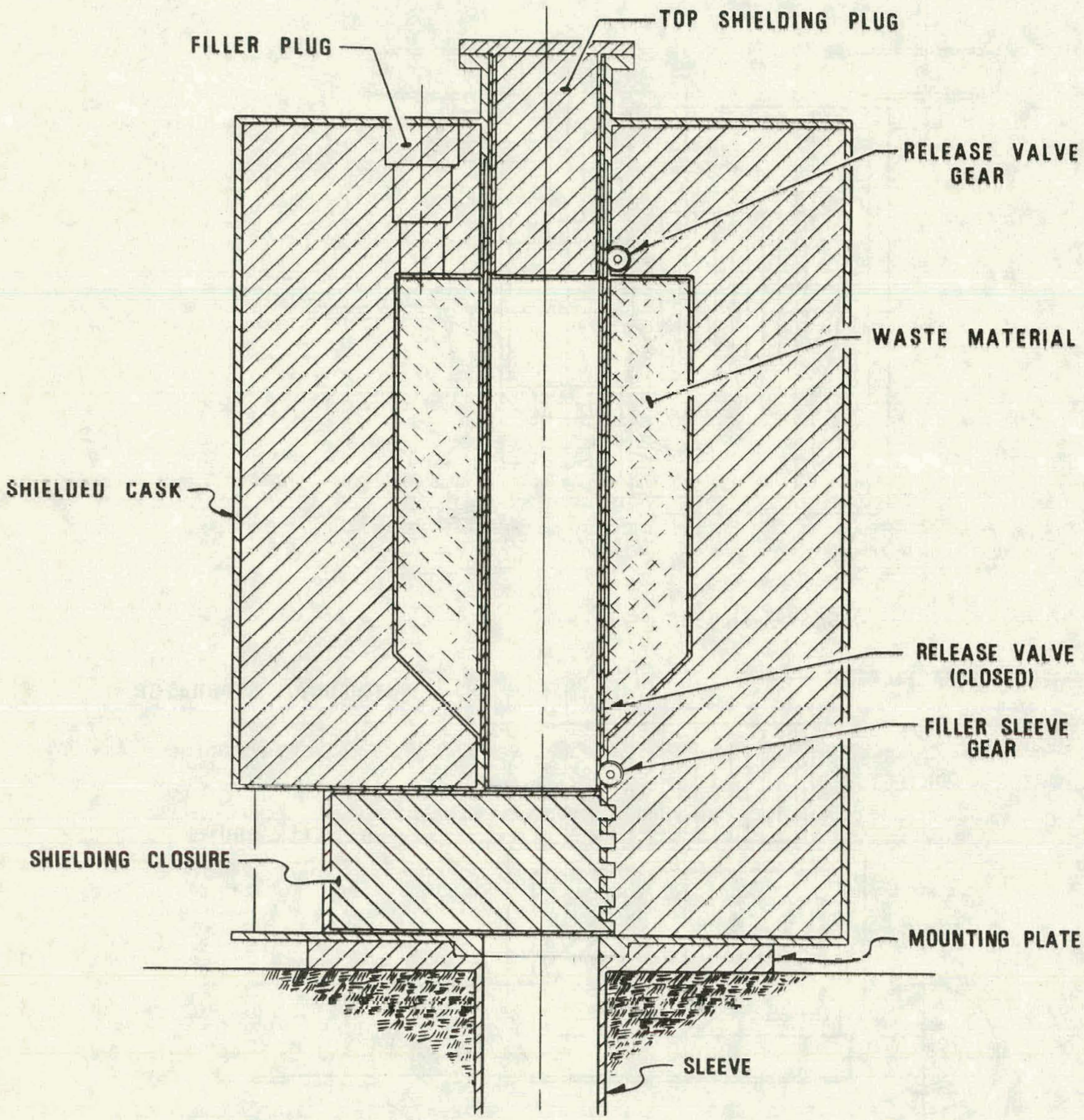


Figure II. 2-4-2-20. Contaminated drill cutting collector



UNCANISTERED WASTE EMPLACEMENT CASK

OPERATION - 1:
ATTACH CASK TO MOUNTING PLATE

Figure II. 2-4-2-21

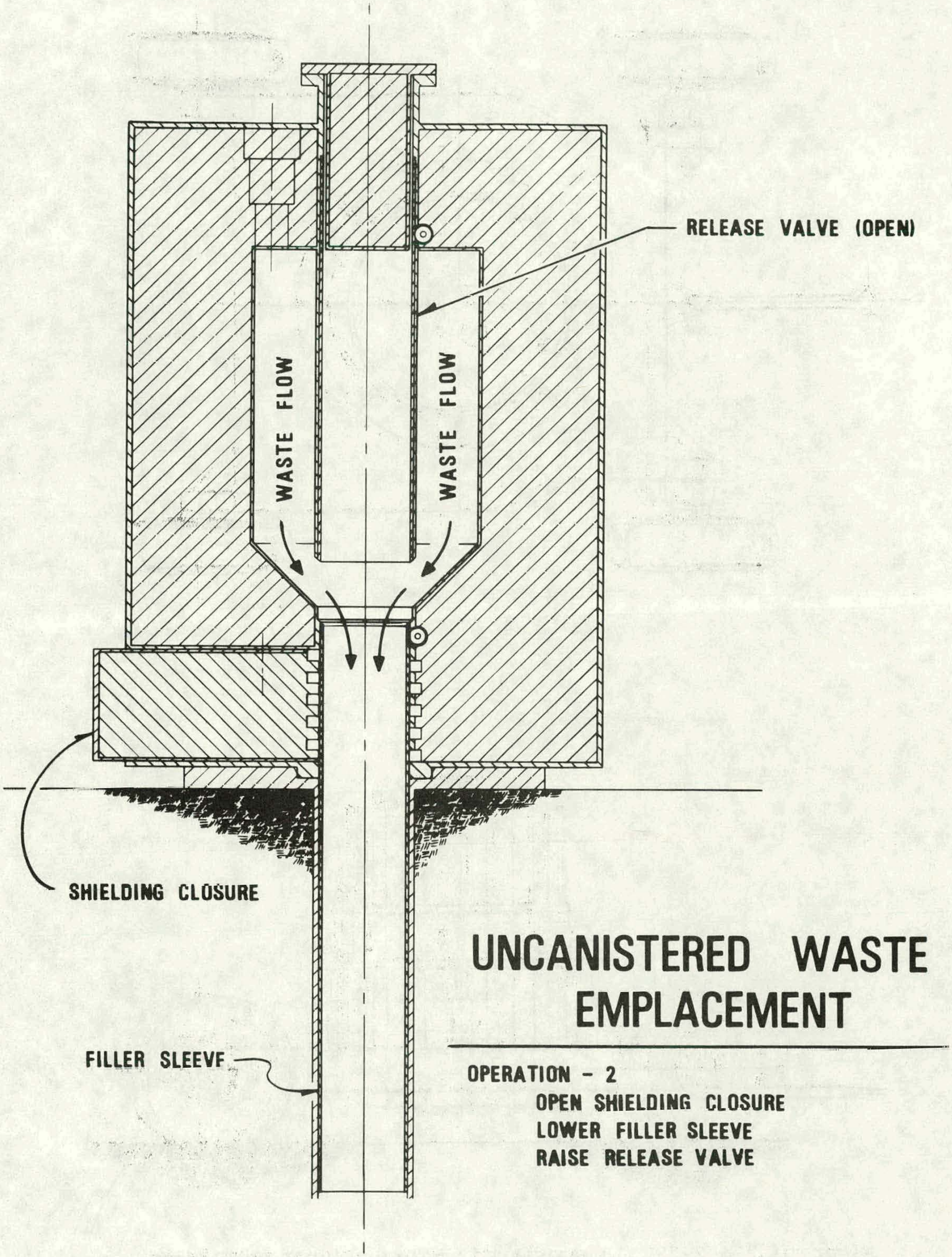


Figure II. 2-4-2-22

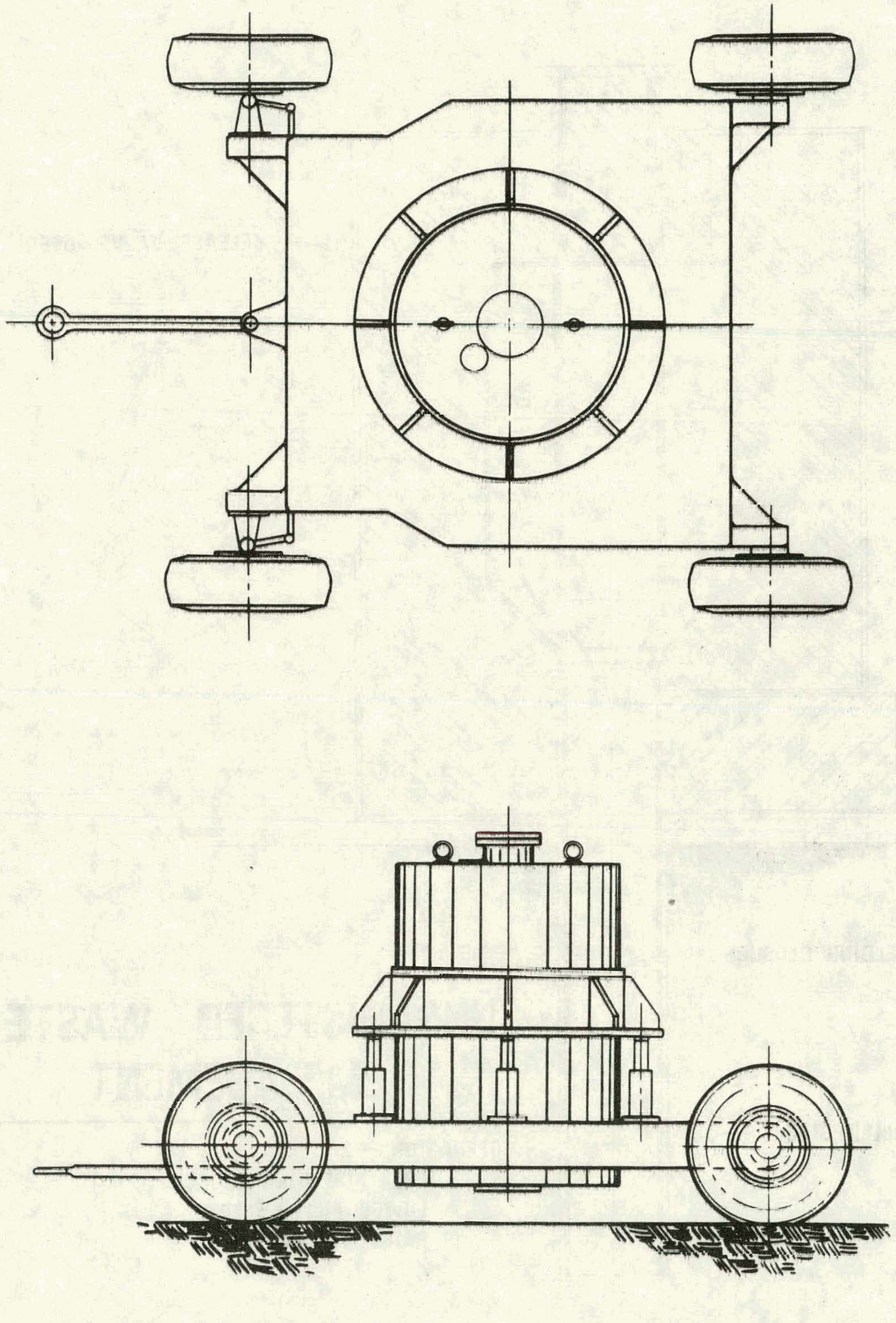


Figure II. 2-4-2-23. Uncanistered waste emplacement trailer

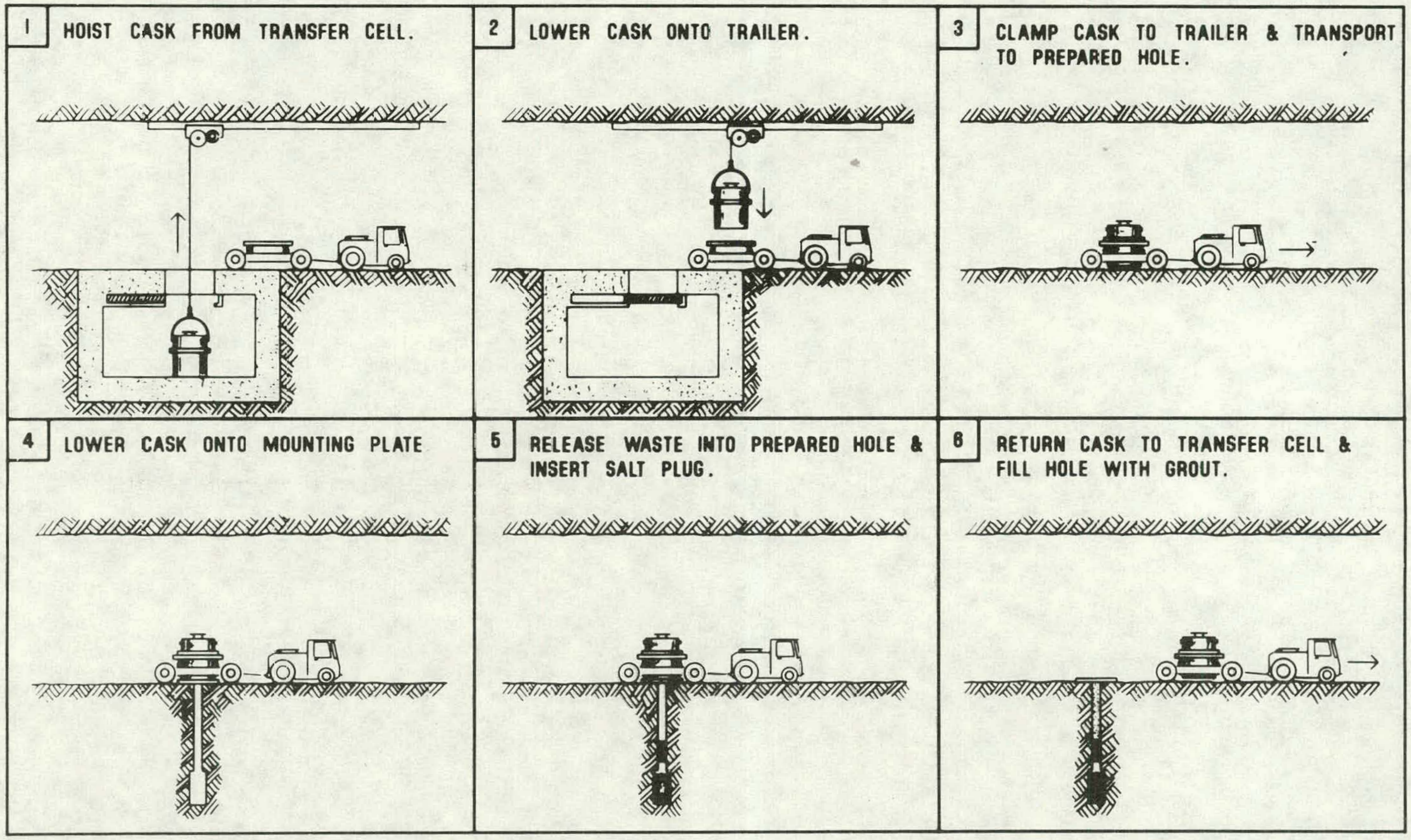
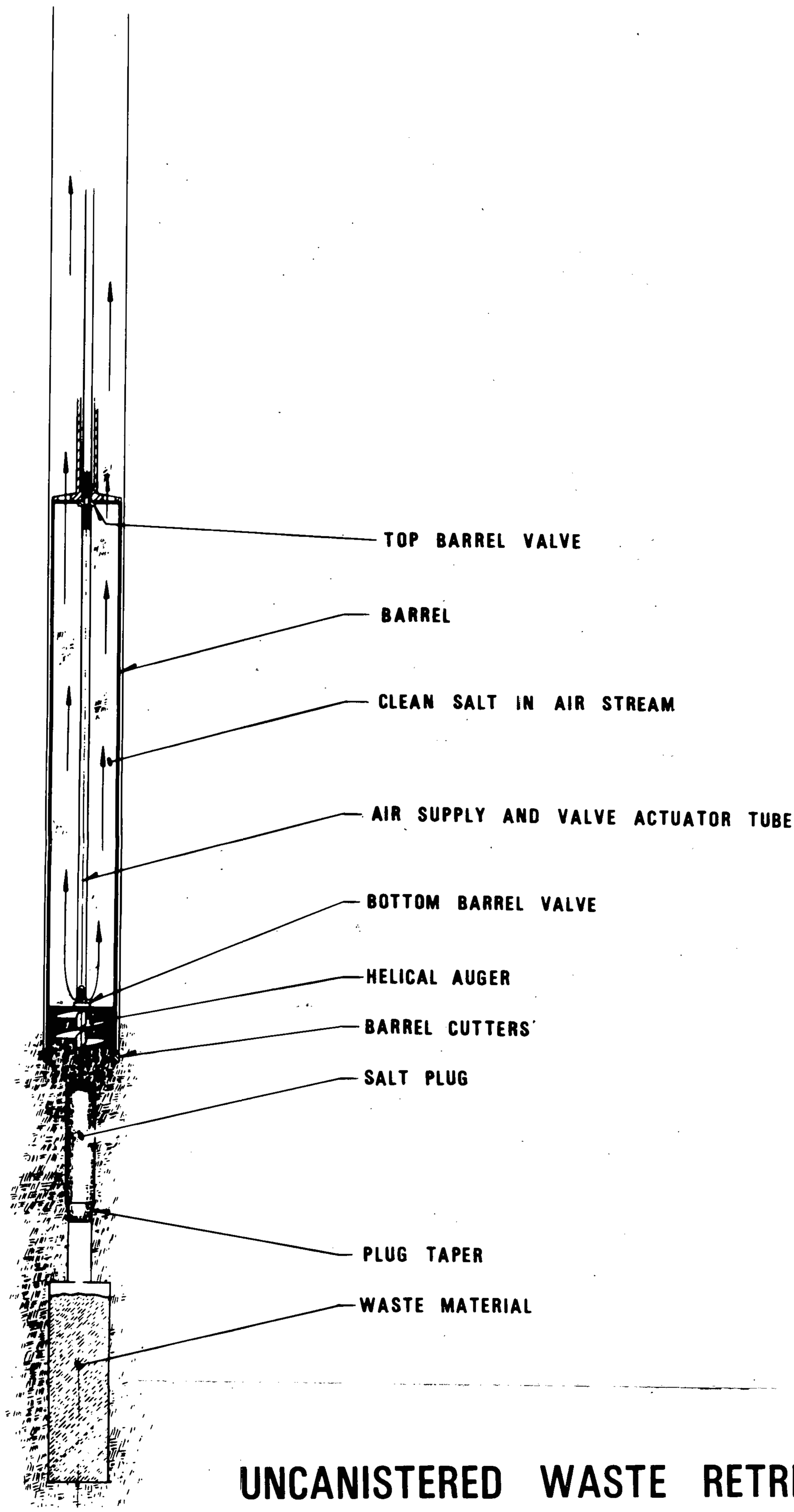


Figure II. 2-4-2-24. WIPP experimental uncanistered waste storage sequence

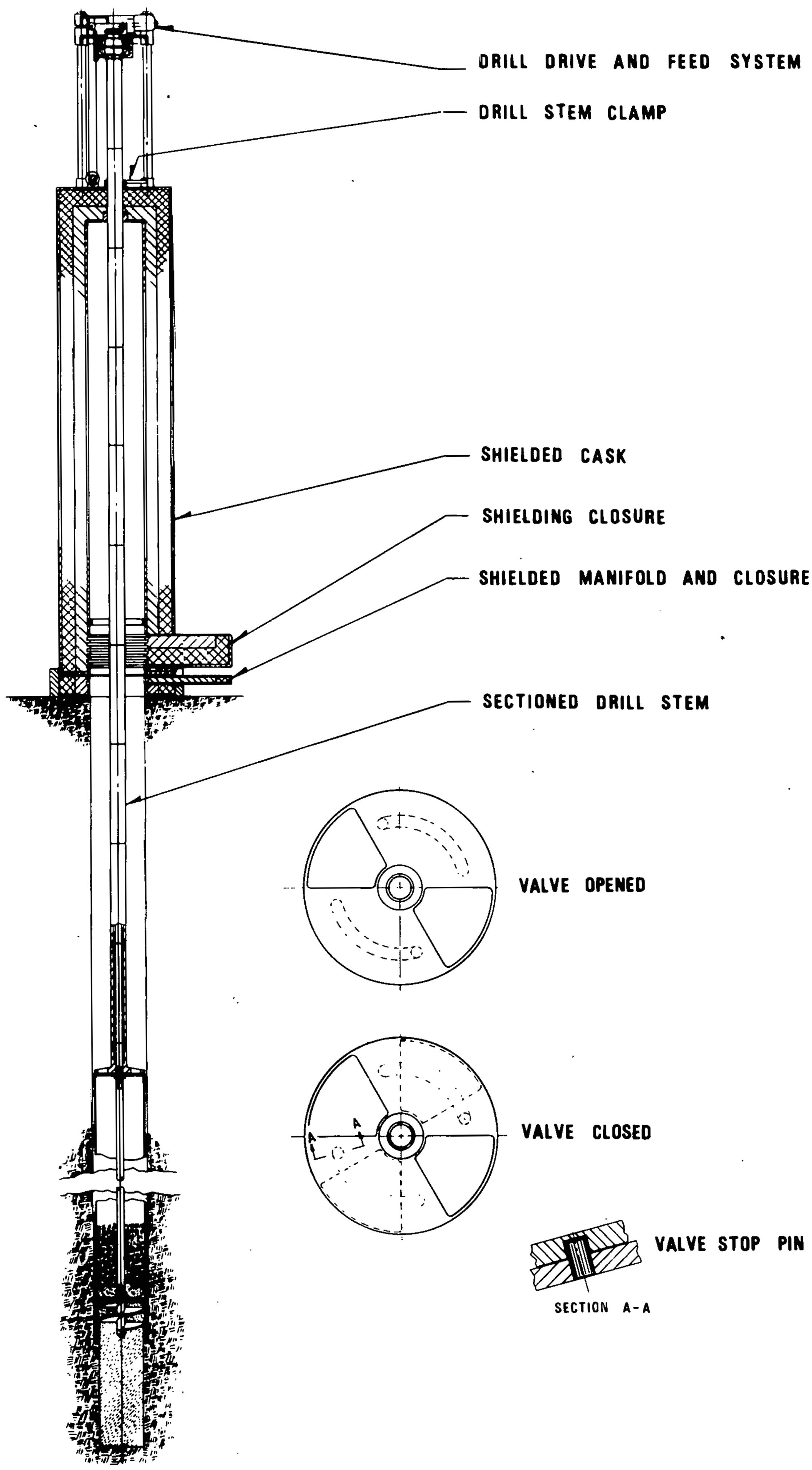


UNCANISTERED WASTE RETRIEVAL

OPERATION - 1:

DRILL TO REMOVE CLEAN SALT

Figure II. 2-4-2-25.



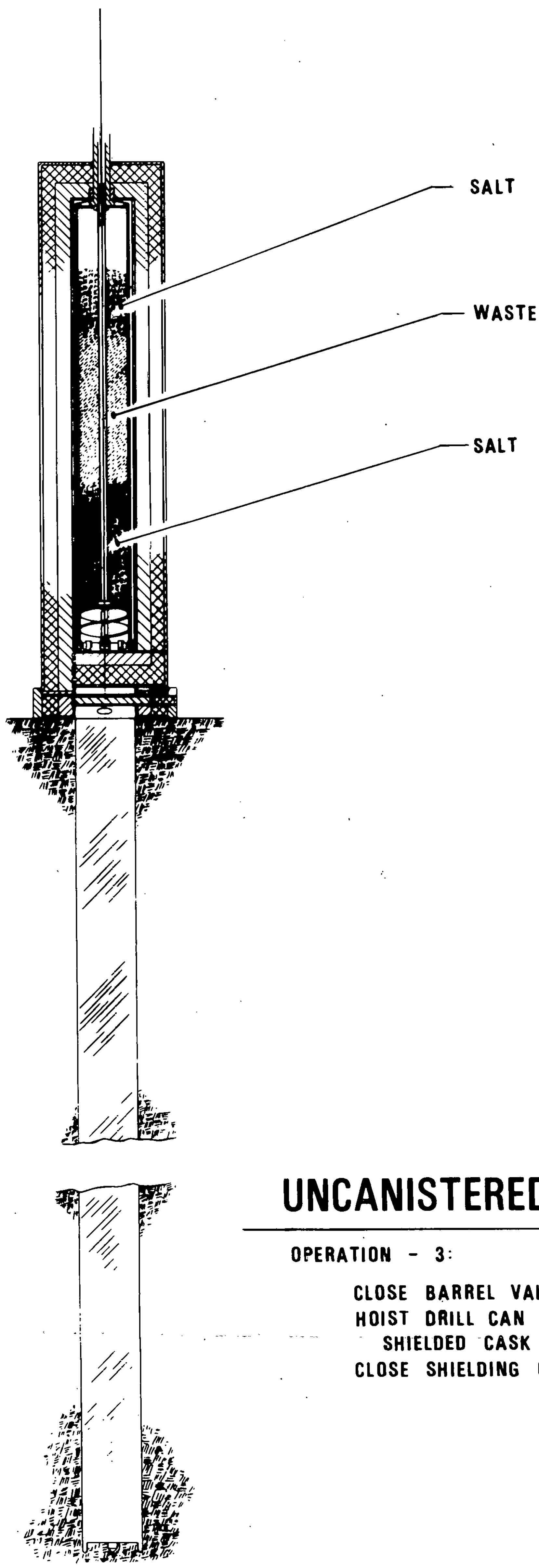
UNCANISTERED WASTE RETRIEVAL

OPERATION - 2 :

AIR OFF

AUGER WASTE MATERIAL INTO DRILLCAN BARREL

Figure II. 2-4-2-26.



UNCANISTERED WASTE RETRIEVAL

OPERATION - 3:

CLOSE BARREL VALVES
HOIST DRILL CAN CONTAINING WASTE MATERIAL AND SALT INTO SHIELDED CASK
CLOSE SHIELDING CLOSURE

Figure II. 2-4-2-27.

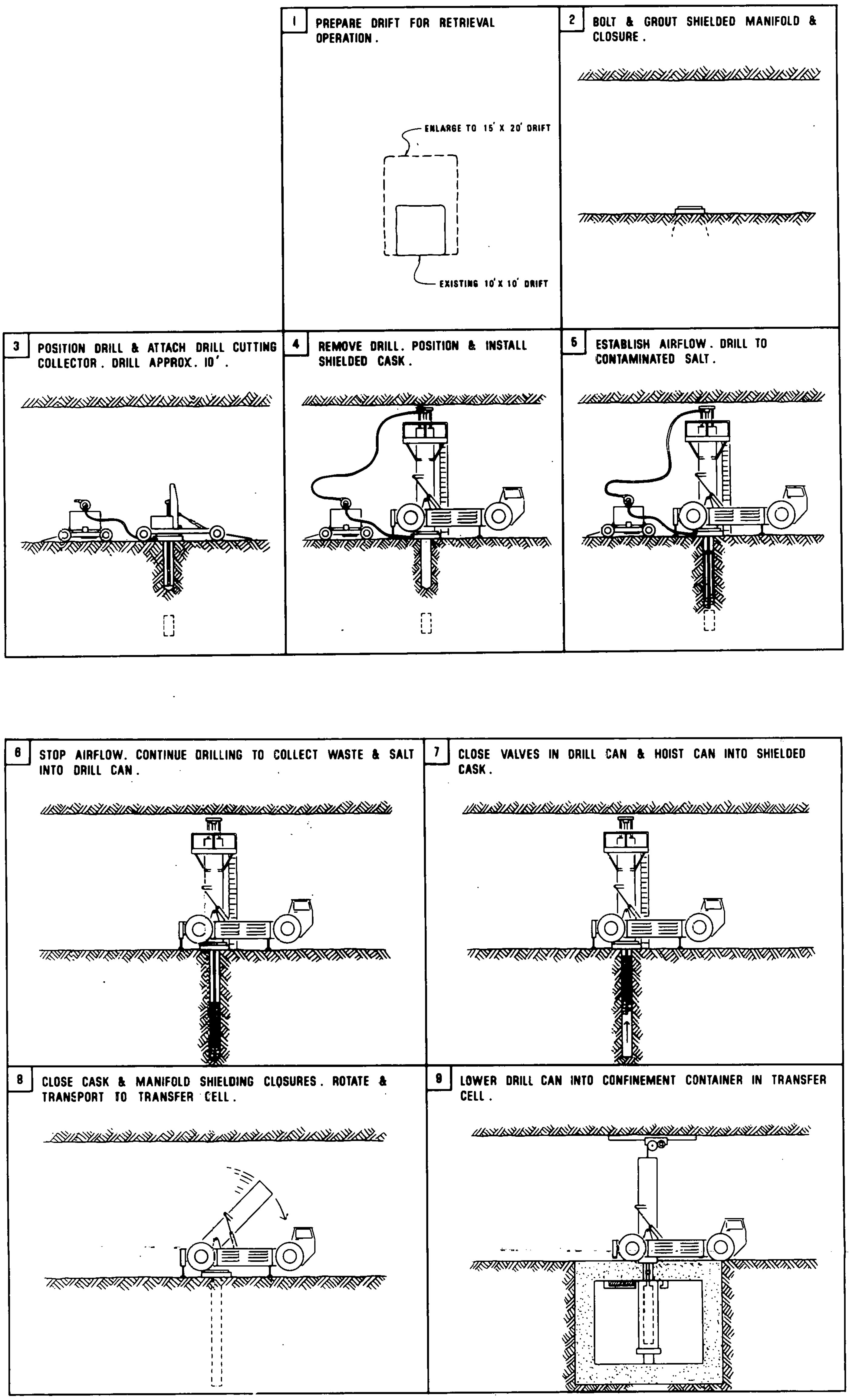


Figure II. 2-4-2-28. WIPP experimental uncanistered waste retrieval sequence

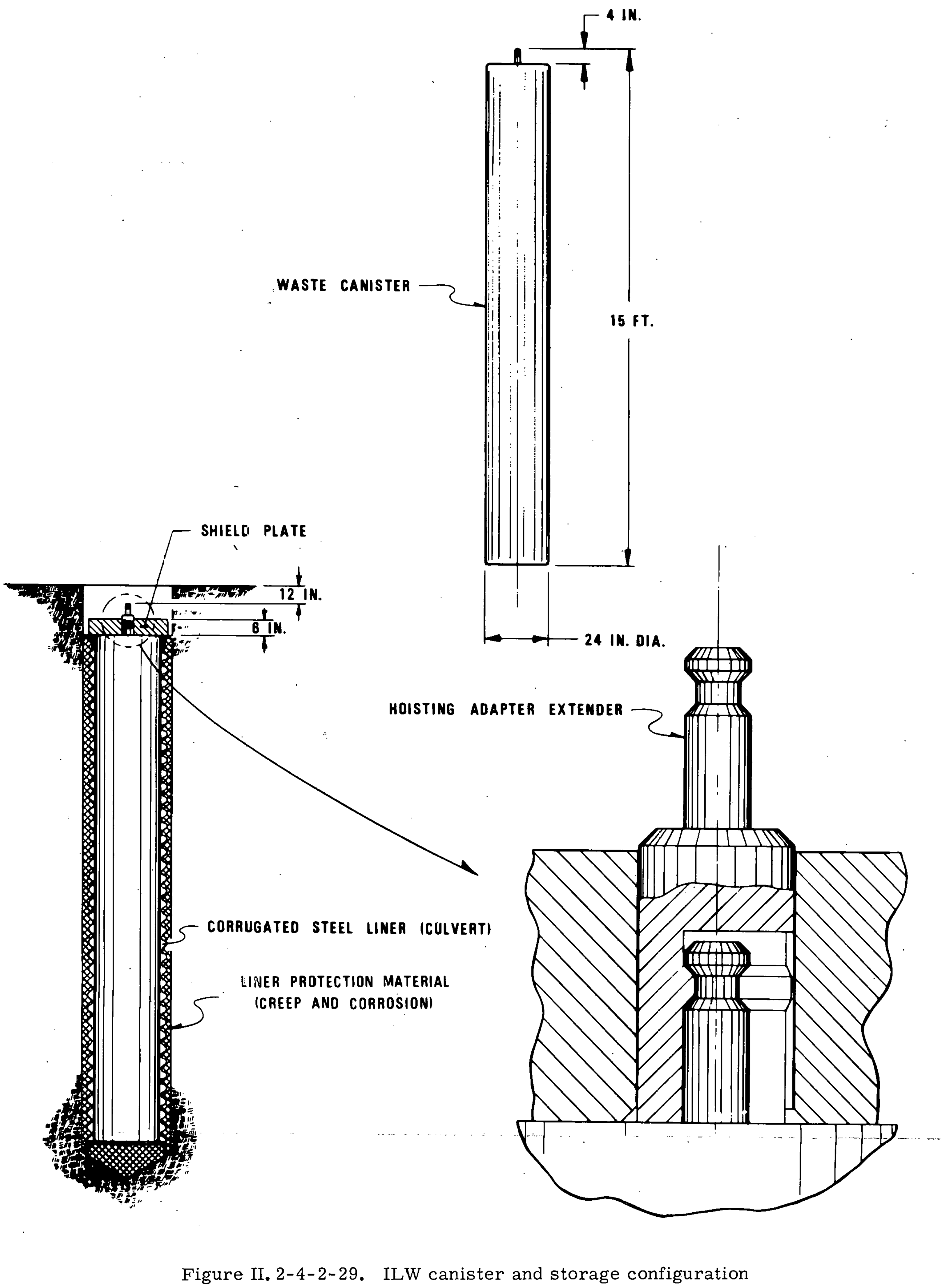


Figure II. 2-4-2-29. ILW canister and storage configuration

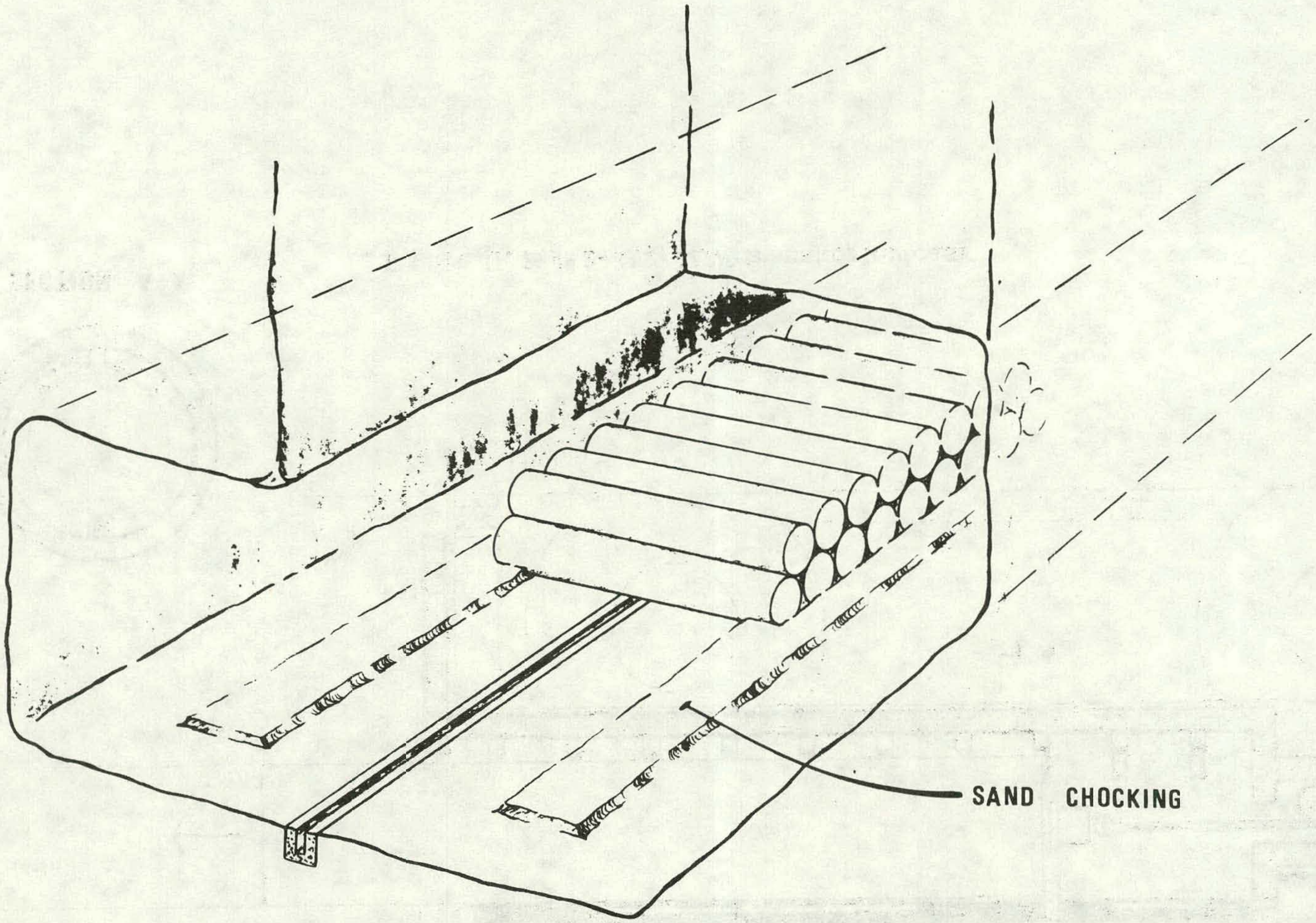


Figure II. 2-4-2-30. ILW post-WIPP storage configuration

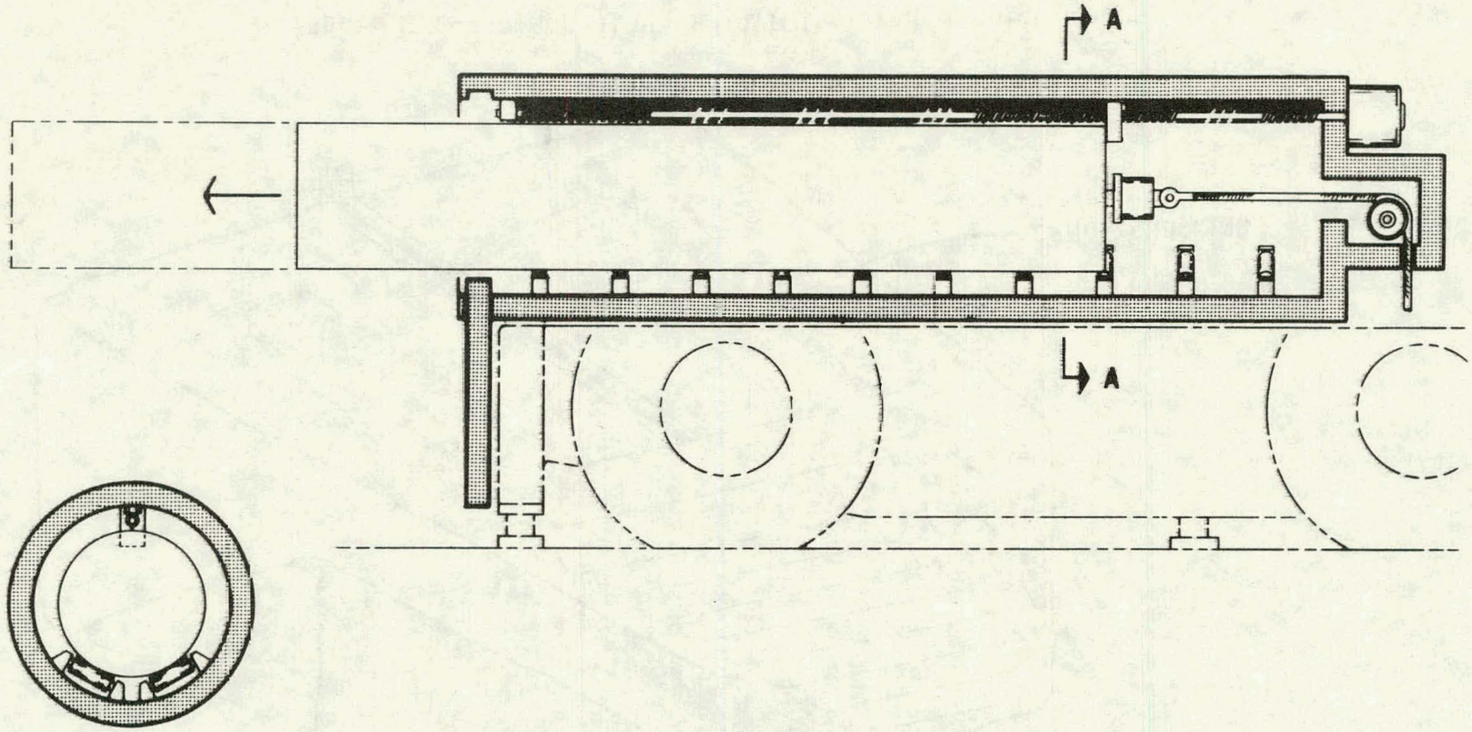


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Figure II. 2-4-2-31. ILW transporter cask

[redacted]

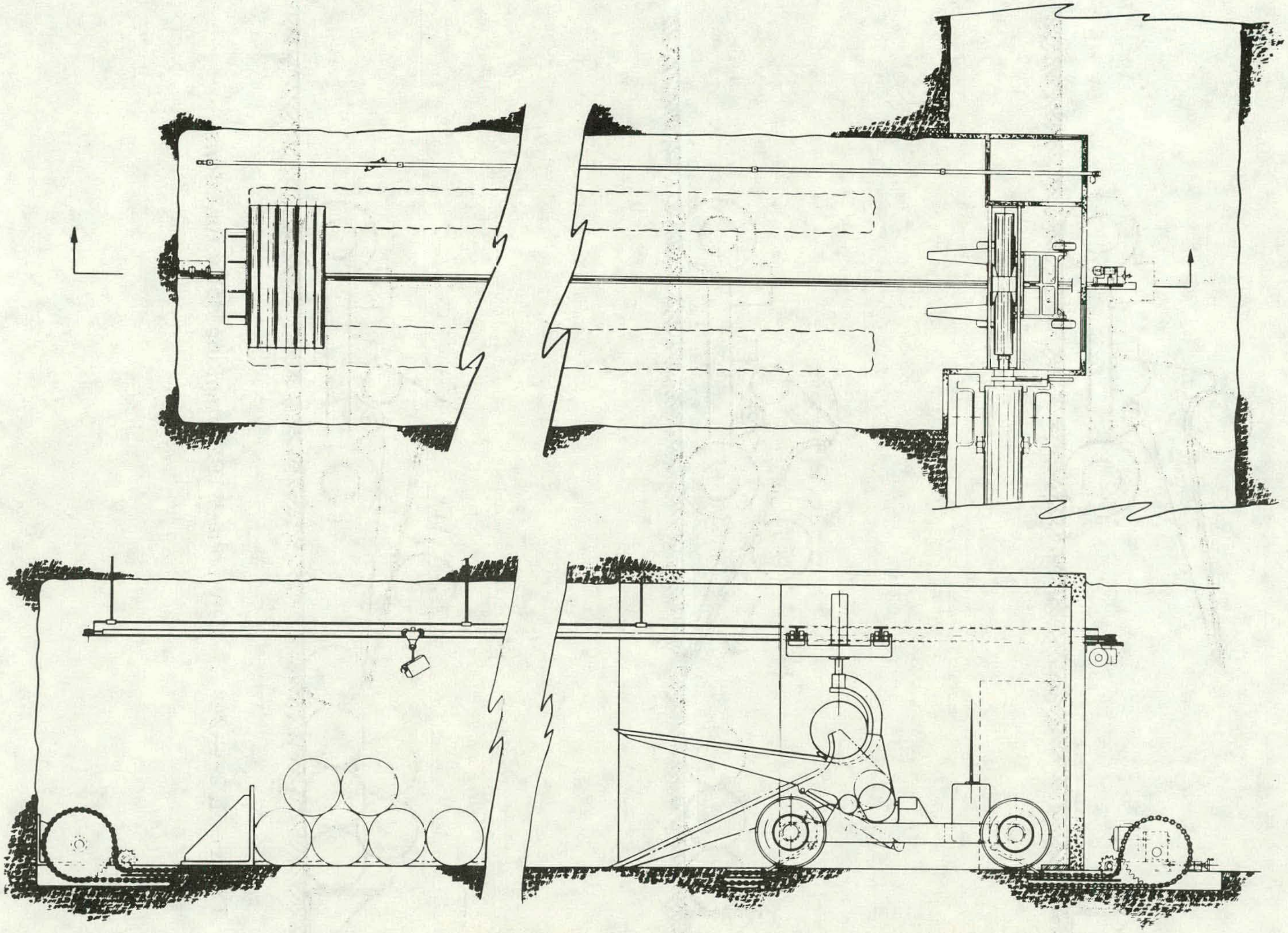

Figure II. 2-4-2-32. ILW post-WIPP storage system

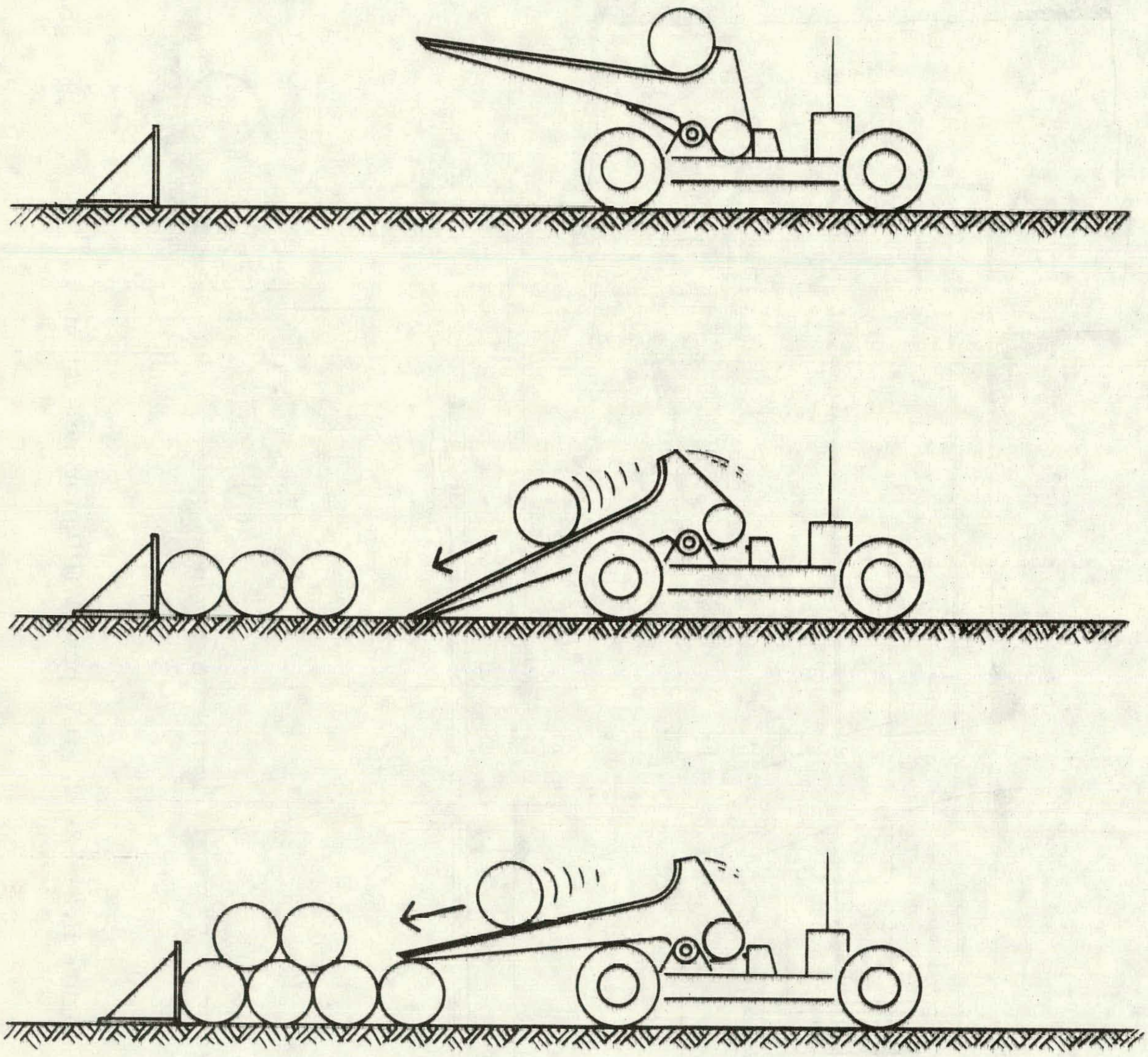

Figure II. 2-4-2-33. ILW post-WIPP stacking dolly functions

3. SUPPORT FACILITIES

3.1 ADMINISTRATION FACILITY

The Administration facility provides general support services for all facilities and activities on the WIPP site. As shown in Drawings 94543, it is divided into administrative, security operations, and operations control areas.

Administration Area

This area provides space for ERDA personnel, contractor personnel, visitors and services, and is separated as follows:

Space	Function
Lobby	Space for a receptionist and/or guard, seating for approximately 10 visitors, and an adjacent display area for models and photographs.
Administration and Technical Offices	Space for administrative functions to support plant operations; and space for ERDA and contractor personnel, accounting, finance, personnel, health-physics, safety, inventory control, engineering, central files/technical library and reproduction, and conference room. Movable office partitions based on a 4' x 6' modular layout are used in this area.
Presentation and Conference Room	Space to seat 50 persons using movable seating. It is used for audiovisual programs that introduce and explain the WIPP and related subjects, for instructional and educational purposes, briefings and facility/contractor meetings. It includes a projection room with a rear-screen projector, 16-mm projector, audio system and control desk. A conference room is adjacent to the presentation room.
Reproduction/Mail/Storage Rooms	Space for facility reproduction equipment and for handling incoming/outgoing correspondence as well as storage space for supplies and extra tables and chairs for the presentation room.

Space	Function
Toilets	Men's and women's toilets with fixtures for the physically handicapped near the receptionist/presentation area. Additional men's and women's toilets are near the cafeteria/reproduction area but do not contain provisions for the physically handicapped. Janitors' closets are provided at each set of toilets.
Cafeteria	Dining: Seating space for 150 persons, a condiment island with water dispenser and a vending-machine area. Serving: Two serving lines and a cashier's station. Food preparation: Space for sandwich/salad preparations, hot food/soup, walk-in refrigerator, walk-in freezer, dishwashing, pot/pan wash. Dry storage rooms, office, toilet and locker area and can wash.
Electrical and Mechanical Equipment Rooms	Space for electrical panels, telephone boards, HVAC equipment, and all miscellaneous mechanical equipment.

Security Operations Area

This area is the center of security activities, and is the main and only entrance to Area B for all pedestrian, rail and roadway traffic:

Space	Function
Security Center	Includes an area with seating for personnel waiting for clearance to Area B. The security receptionist area provides counter space on two sides. The security receptionist issues loop badges to visitors. Loop badges for regular site employees are obtained from the badge rack located in the Area B corridor. Included in the security center is the Area B entrance corridor with loop-badge portals at each end with a remote-control booth between the receptionist and badge rack. The remote-control booth allows personnel access to Area B after normal working hours. The gate control room provides space for a gate-control guard, remote TV displays, and controls to operate the vehicle and rail-

Space	Function
Security Center (cont)	way gates. Offices for badge photographs, the Chief of Security, security personnel, records and files are included as are separate men's and women's toilets.
Fire/Dispensary	Space for a 750-gpm pumper, a security vehicle, a paramedic van, hose-drying racks, the fire inspector's office, and a dispensary with treatment and examination room. Men's and women's toilets are near the fire/first-aid room.

Operations Control Area

This area is the central monitoring point for all activities in the facility:

Space	Function
Central Monitor and Control Room	Houses the HVAC system monitors, process system monitors, alarm system with display boards and a central processing unit in one portion. The remaining area contains security system monitors, display boards and a small computer (see Sec. 4.2.5 for system description).
Computer Room	Space for business and scientific computer system including control console (see Sec. 4.2.6 for system description). Raised floors for cooling plenums and cable routing are provided.
Mechanical Equipment Room	Space for normal and emergency mechanical and electrical equipment and the uninterruptible electrical power supply system (UPS) for the operations control area.
Laboratory	Instrument maintenance and calibration.

3.1.1 ARCHITECTURAL

Functional Space Requirements. Space requirements for the Administration facility are in accordance with the following:

Area	Area (sq ft)	Minimun Overhead Clearance (ft)	Occupant Load*
Administration			
Vestibule/Lobby	825	10	2
ERDA Offices	1512	10	15
WIPP Offices	1299	10	10
Sandia Offices	384	10	3
Cafeteria	4752	10	*(150)
Reproduction	1440	10	3
Personnel	576	10	5
Finance Accounting	960	10	7
Engineering	900	10	10
Electrical/Mechanical	1152	-	-
Health-Physics	1008	10	8
Safety	768	10	5
Central Files Tech Library	768	10	1
Inventory Control	1152	10	10
Conference Room No. 1	288	10	*(12)
Conference Room No, 2	216	10	*(12)
Theater	960	10	*(50)
Storage	192	10	-
Mail Room	216	10	1
Toilets/Janitor Closet	684	8	-
Corridors	2832	10	-
Security Operations			
Vestibules	272	10	-
Waiting	456	10	-
Corridor "B"	288	10	-
Hall	288	10	-
Toilets	96	8	-
Offices	1152	10	8
Operations Control			
Toilets/Janitor Closet	324	8	-
Fire/Dispensary	1596	10	2
Laboratory	720	10	1
Central Monitor	1200	10	4
Computer Room	1728	10	2
Corridor	1312	10	-

Building Materials. A summary of building materials is contained in Section 4.14.

*Seating

3.1.2 STRUCTURAL

Administration/Security Operations. This area of the building is designed for the Category III classification. The structural framing is a system of structural-steel purlins, beams, columns and joists supporting a metal-roof deck and pre-fabricated metal wall panels. The floor is a concrete slab on grade. Foundations are individual column and continuous-wall spread footings.

Operations Control. This section of the building is designed for the Category I classification. The structural framing is typically a poured-in-place reinforced concrete system. The roof is a concrete slab supported on concrete columns and concrete walls. The floor is typically a concrete slab on grade. Foundations are individual column and continuous-wall spread footings.

3.1.3 MECHANICAL

3.1.3.1 Plumbing

Domestic Water System. The estimated cold-water demand for this facility is ~110 gpm. A connection to the domestic water main is provided as shown on Drawing 94534-C1. Domestic hot water for the facility is provided by solar collectors in conjunction with building heating system (see Drawing 94543-M2).

Soil, Waste and Vent System. A standard soil, waste and vent system serves the building toilet room and janitor's closet, and is used for other normal services.

Compressed Air. Compressed air is piped to the laboratory area and the mechanical equipment room. The compressor system is located in the mechanical equipment room.

3.1.3.2 HVAC System

Administrative Areas. The interior zones are served by a medium-pressure, variable-volume (VAV), variable-temperature system; whereas the perimeter zones have a constant-volume, variable-temperature system. Zoning is by means of compensating electronic/pneumatic controls. Heat-recovery-type lighting fixtures are used. The perimeter system operates on recirculated air only and can operate independently in the full bypass mode for standby heating in off hours. The basic system is shown on Drawing 94543-M1.

Cafeteria. This area is served by an HVAC system with economy cycle capability and heat pipes to recover exhaust air heat. The system can be operated in the full recirculation or shutdown mode during off hours. Air pressure in the area is maintained slightly positive with respect to the food preparation area during normal operations, with ~10 percent of the air flow into the food preparation area.

Food Preparation Area. This area is served by a 100-percent fresh-air system using heat pipes to recover heat from the hood exhaust, plus an auxiliary heating coil and air washer cooling. All air is exhausted through fume hoods, and the area pressure is maintained negative with respect to the cafeteria during normal operations by a static pressure controller. The system can be operated in the full recirculation or shutdown mode during off hours.

Computer and Monitor Control Rooms. These areas have freestanding fan/coil units to supply cold air to the below-floor plenum that is ducted into the bottom of each electronic rack and computer module. Air is exhausted out the top of the above-the-ceiling return air system. The room itself is served by an economy-cycle-equipped multizone HVAC unit. Refrigeration is supplied by an independent air-cooled refrigeration unit mounted within the hardened structure.

Labs. This area is served by the multizone system from the computer/control rooms area.

Security and Dispensary. These areas are served by an independent economy-cycle-equipped HVAC multizone unit.

3.1.4 ELECTRICAL

The Administration facility electrical system is described in Section 4.2 and on Drawings 94543-E1 and -E2. The facility electrical loads are described in Table II.4-2-1-1 and Addendum E. The electrical loads are classified as both normal and vital (in Table II.4-2-1-1).

3.2 MAN/MATERIALS BUILDING

The Man/Materials building shown in Drawings 94542 provides facilities for site personnel involved in developing the mine area and in storing waste material in the RH and TRU underground facilities. The building is divided into major areas described as follows:

Area	Function
Lobby and Offices	Space for a receptionist/guard station to control entry to the rest of the building. The office area is large enough to accommodate the mine superintendent, a secretary and a protective clothing issue room located near the entrance to the change rooms. Janitor closets are located next to this area to provide for frequent clean-up of the miners' waiting area.
Change Rooms	Men's Change Room: Space for 150 miners and waste storage handlers. Elevated hanging baskets are used for personal clothing and miscellaneous storage. A gang shower with a capacity for 18 persons with an adjacent drying room, toilet facilities and two low-profile sinks to clean work shoes/boots is provided.
	Women's Change Room: Space for 15 persons. Elevated hanging baskets are used for personal clothing and miscellaneous storage. Personal showers and drying rooms, toilet facilities and a low-profile sink to clean work shoes/boots are also provided. (NOTE: The clothes changing area does not have suspended ceilings due to the hanging baskets.)
	Visitors' Change Room: Space for seven visitors; and lockable personal clothes changing rooms, one toilet, one shower/drying area, and a low-profile sink to clean shoes/boots.
Mine Support Area	Space for four mine shift supervisors and four mining engineers. Space also for the first-aid room that houses first-aid supplies. A mine rescue equipment room for storing required mine-rescue equipment is located next to the first-aid room.

Area	Function
Mine Support Area (cont)	The lamp room provides walk-through aisles and shelving for 200 explosion-proof, lamp-battery-recharging stations. The adjacent lamp-repair room provides space for one repairman and a built-in work counter.
	Personnel moving into or out of the mine pass through the waiting area, which provides bench seating for 50 miners and waste-storage handlers. A "brass board" with 500 pegs to keep track of mine personnel is located on a wall near the lamp room. Three loop-badge stations are located next to the door leading to the man/materials cage-loading areas.
Mechanical/Electrical Room	Houses the water heating and cooling equipment and the electrical distribution panels for the building.

3.2.1 ARCHITECTURAL

Functional Space Requirements. Space requirements are in accordance with the following:

Room Description	Area (sq ft)	Minimum Overhead Clearance (ft)	Occupant Load
Lobby	288	10	1
Offices	288	10	3
Men's Change Room	3186	8	50
Women's Change Room	615	8	5
Visitor's Change Room	477	8	-
Shift Supervisor's Room	570	10	4
Engineer's Room	570	10	4
First-Aid Room	230	10	4
Mine Rescue Equipment Room	228	10	-
Lamp Room	228	10	-
Lamp Repair Room	64	10	-
Waiting Area	624	10	(50)
Mechanical/Electrical Room	780	-	-
Corridors	1368	10	-
Vestibules	267	10	-

Building Materials. A summary of building materials is contained in Section 4.14.

3.2.2 STRUCTURAL

The building is designed for the Category III classification. The structural framing is a system of structural steel purlins, beams, columns and girts supporting a metal-roof deck and metal walls. Standard prefabricated structural components are used. The floor is a concrete slab on grade. Foundations are individual column and continuous-wall spread footings.

3.2.3 MECHANICAL

3.2.3.1 Plumbing

Domestic Water System. The estimated cold-water demand is ~100 gpm. A connection to the domestic water main is provided as shown on Drawing 94534-C1. Domestic hot water for the facility is provided by solar collectors in conjunction with the building heating system.

Soil, Waste and Vent System. A standard soil, waste and vent system serves the building toilet room, janitor's closet, and is used for other normal services.

Compressed Air. Compressed air is piped to work stations in the lamp room and to several places in the mechanical equipment room. The compressor is located in the mechanical equipment room.

3.2.3.2 HVAC System--The HVAC system for the Man/Materials building is an economy-cycle-equipped commercial multizone roof top unit. Cooling is by air washer. Heating is provided by resistance heating elements. One-hundred percent fresh air is used for building ventilation because most space is devoted to locker and change rooms. Fresh air is tempered by a heat recovery system in the exhaust air. This system is based on the TRACE computer results as described in the HVAC Energy Study, Addendum F. Solar assist for space heating and domestic hot water may be justified for this building. Analysis of these items has not been performed, but favorable life cycle cost analysis results have been predicted from similar analyses on other WIPP buildings.

3.2.4 ELECTRICAL

The Man/Materials building electrical system is described in Section 4.2 and Drawing 94542-E1. The facility electrical loads are listed in Table II.4-2-1-1 and Addendum E.

3.3 MAN AND MATERIALS SHAFT AND CONVEYANCES

This shaft connects the surface with both underground levels and is used to move men and materials, remove mined salt, and supply fresh air. Its size was dictated by the amount of salt to be removed, the size of equipment to be lowered underground, and the fresh-air requirements for the underground levels. The shaft conveyances and hoists were determined by the first two of these considerations. This facility will be constructed early in the schedule to allow for underground development.

3.3.1 SHAFT

The 23-ft diameter, 2867-ft deep circular shaft (see Drawing 94571-A1) is lined with concrete from the surface to and including the first 15 ft of the Salado formation. A water ring is provided at this level, and the shaft is unlined the rest of its length. A 130-ft extension below the RH level is required for the skip-loading pocket.

Water Collection System. Seepage into the shaft through the concrete lining is collected by the water ring, piped to a pump station located ~70 ft below, then pumped to the surface. A small sump at the bottom of the shaft collects any water that enters the shaft below the water ring. This liquid is transferred to a tank that is hoisted to the surface and emptied into the liquid radwaste treatment system.

Headframe. This is a Category III structure similar to those used at operating mines having comparable production rates and equipment-handling requirements. It is shown on Drawing 94571-A2.

Shaft Stations. The identical TRU- and RH- level stations (see Drawing 94571-A3) are sized to allow on-station assembly of the continuous mining machines and thus the earliest possible use of this more efficient equipment.

Skip-Loading Pocket. The skip-loading pocket is located ~80 ft below the RH level. Two adjoining measuring pockets that are filled by the main pocket overhead allow quick skip-loading without overfilling. A minus 20 percent incline from the RH level down to the shaft bottom provides access for a front-end loader that cleans up any spillage. A wall separates the cage and skip compartments to confine spillage to the skip compartment. The loading facility is shown on Drawing 94571-A4.

3.3.2 SHAFT CONVEYANCES

A conventional balanced hoisting system using two skips (see Drawing 94571-M1) provides the 2000 ton/shift production hoist capacity required to complete the initial underground development by early 1983. The service hoist and cage are nearly identical to those used for the TRU shaft and are shown on Drawings 94571-M2 through -M4. Similarity in size and payload requirements allowed this standardization. Rigid guides are used for each system since access for maintenance is not a problem. The hoists have the following features:

	Service	Production
Hoist Type	Single Drum (Divided)	Double Drum
Net hoist capacity (tons)	12.5	13
Hoist rope diameter (in.)	2	2
Hoist rope safety factor	4.6	5
Drum diameter (in.)	160	160
Drum face width (in.)	07	174
Motor horsepower	500	900

3.4 MAN/MATERIALS HOISTHOUSE FACILITY

The Man/Materials Hoisthouse facility shown in Drawings 94548 houses equipment to provide services to the man/materials shaft. Hoists for the manned cage and two salt skips are the major equipment items housed in the building. Space is provided for the two hoists and their motors, electrical power supplies, operator cabs, parts storage and associated equipment. A 25-ton bridge crane spanning the width of the building is used to install, maintain, and remove equipment. Roll-up doors are at both ends of the building for equipment access. An office, toilet, and small-parts storage area is provided. A secured portal in the office area serves as the main entrancc access control to the facility.

3.4.1 ARCHITECTURAL

Functional Space Requirements. Space requirements for the Man/Materials Hoisthouse facility are in accordance with the following:

Room Description	Area (sq ft)	Minimum Overhead Clearance (ft)	Occupant Load
Man/Materials Hoisting Room	4500	32	2
Office	192	10	-
Toilet	48	8	-
Security/Lobby	80	10	-
Corridor	64	-	-

Building Materials. A summary of building materials is contained in Section 4.14.

3.4.2 STRUCTURAL

The building is designed for the Category III classification. The structural framing is a system of structural steel purlins, beams, columns and girts supporting a metal-roof deck and metal siding. The floor is a concrete slab on grade. Foundations are individual column and continuous-wall spread footings. Separate concrete foundations bearing directly on the soil are provided for each of the two hoists.

3.4.3 MECHANICAL

3.4.3.1 Plumbing

Domestic Water System. The estimated cold-water demand is ~40 gpm. Domestic hot water for the facility is provided by an electric instantaneous water heater.

Soil, Waste and Vent System. A standard soil, waste and vent system serves the toilet room, janitor's closet, and is used for other normal services. Grease interceptor floor drains are located, where required, in the hoist areas.

3.4.3.2 HVAC System--The building is heated by the hoist motors and electric spot heaters. Air flow is by natural circulation. Cooling is not provided in the hoist area. The hoist control room is heated and cooled by a small heat pump.

3.4.4 ELECTRICAL

The Man/Materials Hoisthouse facility electrical system is described in Section 4.2 and on Drawing 94547-E1. The facility electrical loads are described in Table II.4-2-1-1 and Addendum E.

3.5 RH AND TRU HOISTHOUSE FACILITY

The RH and TRU Hoisthouse facility shown in Drawing 94547-A1 is a below-grade structure that houses hoist equipment for the RH and TRU waste shafts. Access to the hoisting areas is controlled at grade level. The below-grade area provides space for the two separate hoisting rooms and a common office/toilet area. The RH and TRU hoisting rooms each provides space for the hoist, electrical power supplies, operators' cab and associated equipment. Each area has a removable roof panel above the drum of sufficient size to install, provide maintenance for and remove the drum and other hoist equipment. A tunnel connects the hoist room to the lower sheave room of the corresponding RH or TRU facility and provides adequate space for cable guides, visual inspection, and preventive maintenance of the cable.

3.5.1 ARCHITECTURAL

Functional Space Requirements. Space requirements for the RH and TRU Hoisthouse facility are in accordance with the following:

Room Description	Area (sq ft)	Minimum Overhead Clearance (ft)	Occupant Load
Upper Level			
Entry	256	10	-
Stairway	132	-	-
Storage	96	10	-
Lower Level			
RH Hoisting Room	2400	22	1
TRU Hoisting Room	2680	22	1
Office	96	10	-
Toilet	64	8	-
Corridor	192	10	-
Stairway	132	-	-
Janitor Closet	16	8	-

Building Materials. A summary of building materials is contained in Section 4.14.

3.5.2 STRUCTURAL

The building is a below-ground structure with the roof level located approximately at the finished grade level. The structural framing is a poured-in-place reinforced concrete beam and slab system supported on exterior concrete walls. The floor is a concrete slab on grade. Building foundations are continuous-wall spread footings with separate concrete foundations for each of the two hoists.

3.5.3 MECHANICAL

3.5.3.1 Plumbing

Domestic Water System. The estimated cold-water demand is ~40 gpm. Domestic hot water for the facility is provided by an electric instantaneous water heater.

Soil, Waste and Vent System. A standard soil, waste and vent system serves the building toilet room, janitor's closet, and is used for other normal services. Grease-interceptor floor drains are located, where required, in the hoist areas.

3.5.3.2 HVAC System--Drawing 94547-M1 shows the building HVAC flow diagram. Both of the hoist rooms are connected through cable tunnels to their respective waste handling facilities. The building's head-frames are the low pressure sinks of their ventilation systems. Part of the hoisthouse ventilation air always flows from the hoisthouse to the head-frames. Most ventilation air entering the hoisthouse rooms removes heat from the hoist motors and controls, then exhausts to the outside. An enclosed cab is provided for the operator of each hoist and is served by a small heat pump.

The office area and restroom have an independent supply and exhaust system that uses evaporative cooling and heat pipe.

3.5.4 ELECTRICAL

The TRU-RH Hoisthouse facility electrical system is described in Section 4.2 and Drawing 94547-E1. The facility electrical loads are described in Table II.4-2-1-1 and Addendum E.

3.6 VENTILATION SHAFTS

Two exhaust ventilation paths are required to separate the storage and construction exhaust airstreams. Neither the RH nor TRU shaft was used since the large airflows would require extensive modifications to the surface facilities, and since the noncontaminated construction exhaust air would then be passed through a potentially contaminated area. Therefore, two additional shafts for exhaust air are provided.

3.6.1 TRU-RH VENTILATION SHAFT

The 14-ft-diameter, 2737-ft-deep circular shaft (see Drawing 94573-A1) connects the underground levels with the Mine Storage Filter building. A concrete liner extends from the surface to and including the first 15 ft of the Salado formation.

No water handling system is necessary since the airflow velocity within the shaft is high enough to evaporate the small amount of seepage. Obstructions and protrusions have been minimized to facilitate decontamination. Unauthorized and/or accidental personnel entry through the two shaft stations is prevented by chain-link fencing (see Drawing 94573-A2).

A cage and shaft sets with rigid guides provide early underground access for conducting in-situ rock mechanics experiments. Two drifts ~5 ft by 8 ft in cross section by 100 ft long are driven off the shaft on both storage horizons to allow monitoring the deformation of openings and collecting samples for laboratory tests. Before the shaft is used for exhaust purposes, the cage and shaft equipment will be removed and subsequently installed in the construction ventilation shaft to function as part of the mine emergency-escape system.

3.6.2 CONSTRUCTION VENTILATION SHAFT

This shaft is identical to the TRU-RH ventilation shaft except for the emergency-escape system (see Drawings 94574-A1 and -A2). The uncontaminated air exhausted through this shaft by fans installed at the shaft collar (see Drawing 94572-M2) is released without any filtering. Because it connects the surface with both underground levels and cannot be contaminated, the shaft houses the mine emergency-escape system (see Drawings 94572-A3 and -A4 and Section 4.5).

Early completion of the shaft is required so that a connection with the man and materials shaft can be made on each level to obtain adequate ventilation for mining operations. This requirement will be satisfied within the constraint of limiting the number of shaft-sinking crews.

3.7 MINE STORAGE FILTER BUILDING

The Mine Storage Filter building, shown in Drawings 94550, is a two-level, tornado-missile-hardened structure that houses the ventilation equipment required to move and filter 230,000 cfm air from the high- and low-level waste storage horizons of the mine. Mine exhaust air is discharged from the building through a 98-ft stack.

The building provides four equal-sized filter banks to filter storage exhaust air. There are two banks of filters on each floor, one on each side of the building's central corridor. The central corridor provides space for filter bank access air locks, with filter storage on the lower level and washing facilities, a small office, toilet and shower on the upper level. Filters and miscellaneous equipment are raised and lowered from one level to the next with a 1/2-ton monorail hoist.

Each of the four filter rooms is arranged similarly. Air from the mine enters the room through a back draft damper, passes through a spark-arrestor-type prefilter, a medium-efficiency filter, and finally, three stages of HEPA filters. Air is exhausted from each room by static pressure-controlled vortex dampered fan that discharges through a tornado damper to the building stack. The tornado damper protects the integrity of the HEPA filters in the event of a tornado.

Occupied parts of this building are ventilated by air drawn from the outside and discharged through the common stack. Entering air is tempered by heat recovery from the discharge air and is isolated from the mine air by HEPA filters and backdraft dampers.

3.7.1 ARCHITECTURAL

Functional Space Requirements. Space requirements for the Mine Storage Filter building are in accordance with the following:

Room Description	Area (sq ft)	Minimum Overhead Clearance (ft)
Upper Level		
Filter Room		
Air Intake Area (2)	1025 ea	8-1/2
Filter Area (2)	1353 ea	8-1/2
Fan Area (2)	820 ea	8-1/2

Room Description	Area (sq ft)	Minimum Overhead Clearance (ft)
Upper Level		
Air Lock (2)	416 ea	8-1/2
Prefilter Wash Room	576	8-1/2
Office	128	8-1/2
Stack	340	-
Open Floor Space	96	17
Vestibule	240	8-1/2
Lower Level		
Filter Room		
Air Intake Area (2)	1035 ea	8-1/2
Filter Area (2)	1353 ea	8-1/2
Fan Area (2)	820 ea	8-1/2
Air Lock (2)	416 ea	8-1/2
Prefilter Storage	832	8-1/2
Vestibule	476	8-1/2
Stack	340	8-1/2

(NOTE: This building is normally unoccupied except for filter and fan maintenance and testing.)

Building Materials. A summary of building materials is contained in Section 4.14.

3.7.2 STRUCTURAL

The building is designed for the Category I classification. The structural framing is a poured-in-place reinforced concrete beam and slab floor, and the roof system is supported on interior concrete columns and exterior concrete walls. The lower floor is a concrete slab on grade. Foundations are individual column and continuous-wall spread footings.

3.7.3 MECHANICAL

3.7.3.1 Plumbing

Domestic Water System. The estimated cold-water demand is ~35 gpm. A connection to the domestic water main is provided as shown in Drawing 94534-C1. Domestic hot water for the facility is provided by electric water heaters and storage tank.

Soil, Waste and Vent System. A standard soil, waste and vent system serves the building toilet room, janitor's closet, and is used for other normal services.

Compressed Air. Compressed air is piped to work stations.

Special Services. Floor drains in waste handling areas carry radioactive liquids to the radwaste system.

3.7.3.2 HVAC System--Air passing through this building is at a relatively constant year-round temperature. This fact, in conjunction with the massive concrete walls, results in a constant interior temperature. Therefore, supplemental comfort heating or cooling is nominal. The filter storage and cleaning area requires ventilation conditioning. Air is drawn into the building through an intake in the roof, is tempered by a heat pipe and then flows through the filter storage and cleaning areas into a mine fan room through a typical HEPA filter system. The mine exhaust fans provide the motive power for air flow. Drawing 94550-M1 shows the ventilation flow.

3.7.4 ELECTRICAL

The Mine Storage Filter building electrical system is described in Section 4.2 and Drawing 94550-E1. The facility electrical loads are described in Table II.4-2-1-1 and Addendum E. As in other critical WIPP facilities, the electrical loads are classified as both normal and vital. The breakdown of the loads is included in Table II.4-2-1-1.

3.8 SUSPECT WASTE/LAUNDRY BUILDING

The Suspect Waste/Laundry building, shown in Drawings 94551 provides space for a laundry to process protective clothing, and equipment tanks and controls to collect and process radwaste water for recycle or discharge to the suspect waste pond. Refer to Section 4.11 for a discussion of the radwaste system.

The Laundry contains one each washer, extractor, dryer, ironing table, and sink. The liquid waste processing equipment is located in the suspect waste treatment room and includes the miscellaneous liquid waste tank, a detergent waste tank, monitor tanks, pumps and filters. The process demineralizers are located in a separate room adjacent to the main treatment room.

An office exists for supervisory personnel and record storage. Toilet facilities and an electrical room for motor control centers and electrical distribution panels are also provided.

3.8.1 ARCHITECTURAL

Functional Space Requirements. Space requirements are in accordance with the following:

Room Description	Area (sq ft)	Minimum Overhead Clearance (ft)	Occupant Load
Laundry	1152	-	-
Offices (2)	176	10	2
Toilet	48	8	-
Hall	32	10	-
Suspect Waste Treatment Room	3315	-	-
Ion Exchanger Room	240	-	-

Building Materials. A summary of building materials is contained in Section 4.14.

3.8.2 STRUCTURAL

The building is designed for the Category I classification. The structural framing is a poured-in-place reinforced concrete system, with a beam and slab roof system supported on concrete columns and concrete walls. Exterior walls are concrete. The floor is a reinforced concrete slab on grade. Foundations are individual column and continuous-wall spread footings. Combined mat-type footings, bearing directly on the ground, are required in some areas. The process room access entry is protected by a set of two single-leaf, vertically mounted, hinged doors able to resist the tornado wind and negative pressure loads.

3.8.3 MECHANICAL

3.8.3.1 Plumbing

Domestic Water System. The estimated cold-water demand is ~33 gpm (does not include laundry). A connection to the domestic water main is provided as shown in Drawing 94534-C1. Domestic hot water for the facility is provided by solar collectors in conjunction with the building heating system.

Soil, Waste and Vent System. A standard soil, waste and vent system serves the building toilet room, janitor's closet, and is used for other normal services.

Special Systems. Floor drains in waste handling areas will collect liquids for transfer to the radwaste system.

3.8.3.2 HVAC System--The HVAC system for this building is as described below and is shown on Drawing 94551-M1.

Suspect Waste Treatment Area. This area receives air from the building's central supply system (see last paragraph this section) through a pressure-regulating damper that maintains the room pressure slightly below atmospheric pressure. Air is exhausted to the central exhaust system with air supply based on 10 air changes per hour. Supply and exhaust vents are equipped with emergency shutoff and tornado dampers.

Laundry. This area receives air from the central system through a pressure-regulating damper. Pressure in this area is maintained below that of the Suspect Waste treatment area. Air is exhausted into the central exhaust system with air supply based on 12 air changes per hour. Supply and exhaust vents are equipped with emergency shutoff and tornado dampers.

Ion Exchanger Room. This area receives air from the central system through a pressure regulating damper. Air is exhausted into the central exhaust system. This area's pressure is below that of the Suspect Waste treatment area. Air supply is based on 10 air changes per hour. The exhaust vent is equipped with emergency shutoff dampers.

Office and Equipment Room. These rooms receive air from the central system through a pressure regulating damper that maintains pressure above that of surrounding areas. Air exhausts through door louvers into the surrounding areas, and air supply is based on 8 air changes per hour. Air supply vents are equipped with emergency shutoff dampers.

Equipment Selection. The supply air handling unit includes: washable metal mesh prefilters, one stage of roughing filters, an air washer, a heat recovery coil, an auxiliary heating coil, and a fan. The exhaust air handling unit includes a metal mesh spark arrestor with water sprays and eliminators, one stage of roughing filters, two stages of HEPA filters, and two fans, one a standby. A heat recovery coil is included in the common discharge of the two exhaust fans.

3.8.4 ELECTRICAL

The Suspect Waste/Laundry building electrical system is described in Section 4.2 and Drawing 94551-E1. The facility electrical loads are described in Table II.4-2-1-1 and Addendum E.

3.9 EMERGENCY POWER BUILDING

The Emergency Power building shown in Drawings 94546 houses the WIPP facility emergency power generators and the normal and vital power 13.8-kV switchgear. The building is a tornado-missile-hardened structure made of poured-in-place concrete, with all fenestrations protected to abort the penetration of tornado-borne missiles. The building is divided into the following major areas:

Area	Function
Emergency Generator Room	Space for three emergency diesel generators and support equipment, to include starting air compressors, inlet air filtration system, fuel day tanks, and engine electrical systems (with batteries).
Switchgear Rooms (2 rooms, 13.8-kV)	One houses the normal power supply equipment and the other the vital power supply equipment. The normal and vital switchgear rooms are separated by a fire wall.
Service and Control Areas	Space for monitoring generator operation and location of the local control panels. Toilet and office space are provided.
Support Equipment	Space for diesel generator support equipment for engine cooling and exhaust noise muffling.

Refer to Section 4.2.1.3 for a description of the standby power system.

3.9.1 ARCHITECTURAL

Functional Space Requirements. Space requirements are in accordance with the following:

Area	Area (sq ft)	Minimum Overhead Clearance (ft)	Occupant Load
Office	96	10	(1)*
Toilet	48	8	-
Control Room	156	10	-
Hall	90	10	-
Emergency Feeder Breaker Room	1008	10	-

* Parttime

Area	Area (sq ft)	Minimum Overhead Clearance (ft)	Occupant Load
Normal Feeder Breaker Room	1008	10	-
Diesel Generator Room	4228	-	-
Radiator and Exhaust Room	1512	-	-

Building Materials. A summary of building materials is contained in Section 4.14.

3.9.2 STRUCTURAL

The building is designed for the Category I classification. The structural framing is a poured-in-place reinforced concrete system, with the beam-and-slab roof supported on a system of concrete columns and concrete-bearing walls. Exterior walls are concrete. The floor is a slab on grade. Foundations are individual column and continuous-wall spread footings.

3.9.3 MECHANICAL

3.9.3.1 Plumbing

Domestic Water System. The estimated cold-water demand is ~26 gpm. A connection to the domestic water main is shown on Drawing 94534-C1. Domestic hot water for the facility is provided by an instantaneous electric water heater.

Soil, Waste and Vent System. A standard soil, waste and vent system serves the building toilet room, janitor's closet, and is used for other normal services. Grease interceptor floor drains are used to separate accidental spills of fuel and lubricating oils from water.

Special Systems. Fuel oil lines, starting compressed air lines, and radiator cooling water lines run in floor trenches.

Compressed Air. Compressed air is used to start the diesel generators. This building has two independent compressed-air systems. The first system has three individual skid-mounted electric-motor-driven air compressor-receiver units, with one skid-mounted battery-start gasoline-engine-powered air compressor that backs up the electric-powered compressors. The second system is for house air and is a modest duplex compressor mounted on the receiver.

3.9.3.2 HVAC System--Ventilation of the generator room during operation of the diesels is provided by the draft from the fans on the radiator coolers. The air flow cools the engine oil coolers and removes radiant heat from the engines. The electrical equipment rooms are ventilated, and the battery charging station enclosures have powered exhausters to reduce the possibility of hydrogen buildup. The office, control room, and toilet rooms are ventilated from a roof-top unit that includes evaporative cooling and electric resistance heating. Spot heaters are located throughout the building to provide freeze protection for systems and equipment.

3.9.4 ELECTRICAL

The Emergency Power building electrical system is described in Section 4.2 and Drawing 94546-E1. The facility electrical loads are described in Table II.4-2-1-1 and Addendum E. As in other critical WIPP facilities, the electrical loads are classified as both normal and vital. The breakdown of the loads is included in Table II.4-2-1-1.

3.9.5 FUEL STORAGE

Fuel for the emergency diesel generators is stored in the individual unit day tanks and in the buried bulk storage tanks. Each generator's day tank has a capacity of 500 gal. Two buried horizontal tanks, located as shown on Drawing 94534-C1, provide a total of 100,000 gal of fuel storage, enough fuel for a minimum of 7 days' operation of the system at the emergency load of 5.2 MWe plus reserve capacity for testing. Operation at reduced emergency load extends the operating time prior to refueling.

Fuel is supplied to the generator day tanks through buried piping. Two fuel pumps (one spare) are provided at the tank location. Either pump can supply fuel to any or all generators from either of the tanks.

See Section 4.2.9.3 for cathodic protection of fuel oil storage tanks and piping.

3.10 WAREHOUSE/SHOPS

The Warehouse/Shops building shown in Drawings 94544 houses personnel and equipment required to maintain the site and all its surface facilities. Tasks performed here are the loading, unloading and subsequent storage of material and equipment from trucks and railcars and the assembly, repair, or preventive maintenance of miscellaneous items and equipment. The Warehouse/Shops is divided into four areas described as follows:

Area	Function
Office	Space for maintenance personnel in supervisory or administrative positions, and a conference room. Locker rooms and showers are provided for both men and women and are large enough to accommodate a locker for each person working in the building. Toilet rooms are provided for both men and women near the office area.
Filter Cleaning Room/Shops	Space for automatic equipment to wash, oil, and dry the fresh-air filters from other site facilities. The shop area accommodates the following functions: paint (to include dry cross-flow spray booth), carpentry (to include cyclone-type dust collector), sheet metal, air conditioning, plumbing, electrical, millwrights and machine. Personnel and roll-up doors to exterior are provided for each shop area. The paint and carpentry shops and the filter cleaning rooms are separated from all other areas by 2-hr fire walls.
Warehouse and Dock	Receipt, storage, and distribution of materials required for WIPP operation. Both areas are at the same elevation to make it easier to unload from railcars and trucks.
Mechanical/Electrical Equipment Room	Space for heating, ventilating and air-conditioning equipment, domestic hot-water equipment, an air compressor, and the electrical distribution panels.

3.10.1 ARCHITECTURAL

Functional Space Requirements. Space requirements for the Warehouse/Shop are in accordance with the following:

Room Description	Area (sq ft)	Minimum Overhead Clearance (ft)
Offices	1980	10
Men's Locker Room	270	8
Woman's Locker Room	168	8
Men's Toilet	324	8
Women's Toilet	315	8
Janitor's Closet	81	8
Corridor	564	10
Mechanical/Electrical Room	660	-
Filter Cleaning Room	720	-
Shops		
Paint	720	-
Carpentry	720	-
Sheet Metal	720	-
A/C	720	-
Plumbing	720	-
Electrical	720	-
Millwrights	720	-
Machine	720	-
Storage	4320	-
Dock	1560	-

Building Materials. A summary of building materials is contained in Section 4.14.

3.10.2 STRUCTURAL

The building is designed for the Category III classification. The structural framing is a system of structural steel purlins, beams, columns and girts supporting a metal-roof deck and metal walls. Standard prefabricated structural components are used. The floor is a concrete slab on grade. Foundations are individual column and continuous-wall spread footings.

3.10.3 MECHANICAL

3.10.3.1 Plumbing

Domestic Water System. The estimated cold-water demand is ~67 gpm. A connection to the domestic water main is as shown on Drawing 94534-C1. Domestic hot water for the facility is by solar collectors in conjunction with the building heating system.

Soil, Waste and Vent System. A standard soil, waste and vent system serves the building toilet room, janitor's closet, and is used for other normal services.

Compressed Air. Compressed air is piped to work stations.

3.10.3.2 HVAC System--The storage area of the Warehouse is not cooled. Spot electric radiant heating is provided to protect critical supplies stored here. Shops in the building are provided with a once-through ventilation system to assure acceptable air quality in the work areas. An evaporative system provides cooling. Spot electric radiant heating is used. The office and locker room area is served by a rooftop multizone unit that uses evaporative cooling, electric resistance heating, and heat recovery. One-hundred percent outside air is provided to the locker room areas. Selection of this system is based on the results of the TRACE analysis for the Man/Materials building, a building of function comparable to this area of the Warehouse/Shops building.

3.10.4 ELECTRICAL

The Warehouse/Shops building electrical system is described in Section 4.2 and Drawing 94544-E1. The facility electrical loads are described in Table II.4-2-1-1 and Addendum E.

3.11 UNDERGROUND SUPPORT AREAS

Identical facilities to support the mining and storage operations are located within the shaft area on both the TRU and RH levels. A computer room added on the RH level supports the experimental program.

3.11.1 SHOPS AND WAREHOUSE

This area is similar to those found at conventional mechanized mines. Each shop area is conveniently located near the man and material shaft and contains: a heavy repair bay, welding bay, lubrication bay, electrical shop, conveyor repair shop, several storage areas and a warehouse (see Drawing 94572-A1). In addition, there are a small lunchroom for shop personnel, an office for maintenance supervisory personnel and restrooms.

Underground repairs will be limited by practical or economical considerations, and repairs that require sophisticated or expensive tools along with highly skilled workmen will be contracted to specialized shops. Major parts replacement overhauls, preventive maintenance, field repairs and minor fabrication work will be a part of normal operations. A bridge crane relocated from the man and materials shaft station will allow work on the larger mobile equipment. The less mobile mining machines will be serviced at the working sites with crew mobility provided by service trucks.

The warehouse is stocked for daily operations. Parts that require a controlled storage environment are kept in the surface warehouse.

3.11.2 RADSAFE CHECK STATION

A radsafe check station (see Drawing 94572, Sheet A2) is located on each level to check the waste handlers for contamination as they leave the waste-handling area. This procedure reduces the probability of contaminating areas not devoted to waste storage operations.

3.11.3 DECONTAMINATION STATION

An area for personnel and equipment decontamination that can accommodate the largest piece of mobile equipment on each level is provided. Portable personnel showers and clean clothing are located within each station. This station is shown on Drawing 94572-A2.

3.11.4 COMPUTER ROOM

The computer used to monitor the waste experiments is installed in a separate room on the RH level. The room has a concrete floor, two 2.5-ton air conditioners (one is redundant), and is connected to UPS (see Section 4.2.1.9).

3.11.5 ELECTRICAL SUBSTATIONS

The main substations containing high-voltage transfer switches are near the man and materials shaft in an entry leading directly to the construction ventilation shaft. This location is convenient to the main power lines, and in the event of a fire, allows smoke and fumes to be exhausted immediately, thus preventing their spread.

Portable skid-mounted load centers that provide working voltages are located where needed particularly at conveyor drives and near the mining face.

3.11.6 FUEL STORAGE

Fuel and lubricant storage for the diesel-powered mobile equipment is located near the shop area. A connection to the construction ventilation shaft allows direct exhausting of smoke or fumes from a fire.

3.12 VEHICLE MAINTENANCE FACILITY

The Vehicle Maintenance facility shown in Drawings 94545 provides for tuneups, minor overhaul and preventive maintenance for site vehicles and for storing associated vehicle parts and equipment. The lubrication and maintenance area includes two hydraulic lifts and a portable hoist. An office for the motor pool dispatcher and records room to store maintenance manuals and vehicle maintenance records exists. Additional areas include a toilet, workshop and parts storage, tool crib and tire storage.

An outdoor fuel dispensing station is adjacent to the Vehicle Maintenance facility. It consists of a covered pump station having two pumps on a central raised island. Water for vehicles and compressed air is provided at the island. Four buried 10,000-gal fuel storage tanks are located near the island as shown on Drawing 94533-C1. See Section 4.2.8.2 for cathodic protection of fuel oil storage tanks and piping.

3.12.1 ARCHITECTURAL

Functional Space Requirements. Space requirements are in accordance with the following:

Room Description	Area (sq ft)	Minimum Overhead Clearance (ft)	Occupant Load
Office and Records	144	10	1
Work Shop and Parts	204	10	1
Tool Crib and Tire Storage	240	-	-
Lubrication and Preventive Maintenance	1452	-	-
Fuel Pump's Area	-	-	-

Building Materials. A summary of building materials is contained in Section 4.14.

3.12.2 STRUCTURAL

The building is designed for the Category III classification. The structural framing is a system of structural steel purlins, beams, columns and girts supporting a metal-roof deck and metal siding. Standard prefabricated structural components are used. The floor is a concrete slab on grade. Foundations are individual column and continuous-wall spread footings.

3.12.3 MECHANICAL

3.12.3.1 Plumbing

Domestic Water System. The estimated cold-water demand is ~33 gpm. A connection to the domestic water main is shown on Drawing 94534-C1. Domestic hot water for the facility is provided by an instantaneous electric water heater.

Soil, Waste and Vent System. A standard soil, waste and vent system serves the building toilet room, janitor's closet, and is used for other normal services. Grease interceptor-type floor drains are strategically located.

Compressed Air. Compressed air is piped to work stations and the fuel dispensing island.

3.12.3.2 HVAC System--Electric resistance spot heating is provided in the vehicle maintenance and parts storage area. The spot heaters also provide freeze protection. Ventilation, supplemented by evaporative cooling and resistance heating, is provided in the office and restroom areas by a roof-top unit.

A central vehicle exhaust collection system is ducted to each vehicle bay.

3.12.4 ELECTRICAL

The Vehicle Maintenance facility electrical system is described in Section 4.2 and Drawing 94545-E1. The facility electrical loads are described in Table II.4-2-1-1 and Addendum E.

3.13 SITE ENTRANCE GATEHOUSE

The Site Entrance Gatehouse shown in Drawings 94549 provides security for Areas A and B by controlling all vehicular, foot and railway traffic entry to the site. The building is divided into the following areas:

Area	Function
Visitor Registration	Initial control point for all site visitors, separated by a counter with a dropleaf door from the remainder of the building. Contains both public and site telephones.
Guard/Office Areas	Guard area: space for a guard and the communication equipment required to register visitors and control their access into Area A.
	Office area: space for one guard and communication/closed-circuit TV equipment connected to the other site facilities. Toilet facilities are provided in this part of the building.

3.13.1 ARCHITECTURAL

Functional Space Requirements. Space requirements for the site entry gatehouse are in accordance with the following:

Room Description	Area (sq ft)	Minimum Overhead Clearance (ft)	Occupant Load
Visitor Registration	92	8	-
Guard Room	115	8	1
Office	109	8	1
Toilet	25	8	-
Janitor's Closet	12	8	-
Hall	48	8	-

Building Materials. A summary of building materials is contained in Section 4.14.

3.13.2 STRUCTURAL

The building is designed for the Category III classification. The structural framing is a corrugated metal roof deck supported on structural steel joists with exterior concrete masonry-bearing walls. The floor is a concrete slab on grade with foundations being continuous-wall spread footings.

3.13.3 MECHANICAL

3.13.3.1 Plumbing

Domestic Water System. The estimated cold-water demand is ~26 gpm. A connection to the domestic water main is provided for this building. Domestic hot water for the facility is by an instantaneous electric water heater (no storage).

Soil, Waste and Vent System. A standard soil, waste and vent system serves the building toilet room, janitor's closet, and is used for other normal services.

3.13.3.2 HVAC System--The site entrance gatehouse uses an electric heat pump to provide heating and cooling. The restroom has an independent exhaust fan.

3.13.4 ELECTRICAL

The Site Entrance Gatehouse electrical system is described in Section 4.2 and Drawing 94543-E2. The facility electrical loads are described in Table II.4-2-1-1 and Addendum E.

3.14 WATER PUMPHOUSES

The Water Pumphouses shown in Drawings 94552 contain the domestic water and fire protection pumps and are located at the northwest and southeast ends of the site. Water chlorination equipment and storage for chemicals are also provided. The buildings are buried structures, with access by a vertical fixed stairs into the entrance pit of each building. This pit is sized for easy installation and removal of equipment. A removable covering is provided over the entrance to eliminate the buildup of sand in the entranceway. The doors are fully louvered. The structure is hardened to meet seismic and tornado missile design criteria.

3.14.1 ARCHITECTURAL

Functional Space Requirements. Space requirements are in accordance with the following:

Room Description	Area (sq ft)	Minimum Overhead Clearance (ft)	Occupant Load
Entrance Pit	200	9	-
Pump Room	520	9	-

Building Materials. A summary of building materials is contained in Section 4.14.

3.14.2 STRUCTURAL

The building is designed for the Category I classification. The building is a below-ground structure with the roof level located approximately at the finished grade level. The structural framing is a poured-in-place reinforced concrete beam and slab system supported on exterior concrete walls. The floor is a concrete slab on grade. Foundations are continuous-wall spread footings.

3.14.3 MECHANICAL

3.14.3.1 Plumbing

Domestic Water System. The pumphouses do not normally require water for internal use.

Soil, Waste and Vent System. Floor drains are provided.

Special Systems. A water chlorinator system is provided complete with gas mask and protective clothing as required.

3.14.3.2 HVAC System--A positive ventilation system is provided for these buildings to purge the building prior to entry due to the presence of chlorine injection equipment. The same ventilation system is thermostatically controlled to prevent overheating of pump motors.

3.14.4 ELECTRICAL

The Water Pumphouse's electrical systems are described in Section 4.2 and Drawing 94552-E1. The facility electrical loads are described in Table II.4-2-1-1 and Addendum E. As in other critical WIPP facilities, the Water Pumphouse's loads are included in the vital load system.

3.15 SEWAGE TREATMENT PLANT

This plant is a prefabricated package unit that uses the activated-sludge, extended-aeration process. Plant capacity is 40,000 gal per day. The plant is ~84 ft long and 12 ft wide with a liquid depth of 9 ft 6 in. and a 1-ft 6-in. free board, for a total depth of 11 ft. It is constructed with welded steel plates and structural steel members as required to withstand outdoor exposure. The steel tank is buried and supported on a concrete foundation slab. Cathodic protection is included in the package unit. For the design flow of 40,000 gpd the plant has an aeration volume of 40,000 gal, clarifier volume of 6,667 gal, a chlorine contact tank of 835 gal and an incoming surge tank of approximately 1000 gal. The plant is equipped with a weatherproof comminutor, a 7-1/2-hp, 200 cfm blower and chlorine contact chamber; the control panel, blower, and chlorinator are housed in weatherproof enclosures. Under normal operating conditions, the plant is designed to provide ~95-percent removal of incoming BOD and suspended solids. Treated effluent flows by gravity from the plant to a 250,000-gal effluent pond, sufficient for 6 days' storage (Fig. II.3-15 shows the pond cross section). Most of the processed effluent is recycled for landscaping irrigation and salt dust control.

Immediately surrounding the sewage treatment plant is a paved area that provides access for maintenance. Yard lighting is provided, as are weatherproof convenience outlets for use by maintenance personnel. The Sewage Treatment plant area is fenced to keep animals and personnel away from the open tank, with gates provided for maintenance access.

Laboratory analysis of effluent is in accordance with current New Mexico regulations. Analyses are performed by an independent test laboratory as required.

The Sewage Treatment plant electrical system is described in Section 4.2 and Drawing 94557-E1. Facility electrical loads are described in Table II.4-2-1-1 and Addendum E.

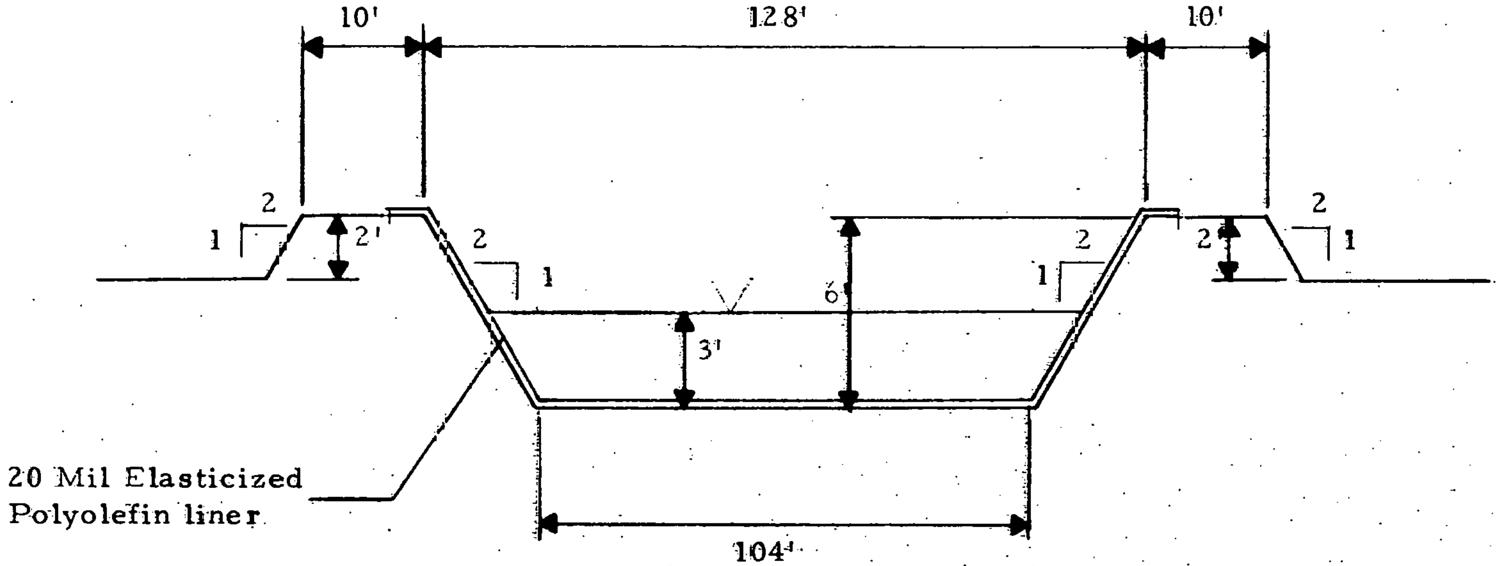

Figure II. 3-15. Sewage effluent pond

4. SYSTEMS

4.1 VENTILATION SYSTEM

The ventilation system is of prime importance for facilities in which hazardous operations are conducted. This is especially true for the WIPP facility. The primary objective of the ventilation design is to ensure that both WIPP personnel and the general public are protected from excessive radiation exposure through various engineered, anisobaric confinement systems. The secondary objective is to ensure viable working conditions for WIPP personnel through proper air movement.

4.1.1 UNDERGROUND VENTILATION SYSTEM

The underground ventilation system consists principally of two levels of storage rooms and access corridors, the vertical shafts used for input and exhaust of air, and the exhaust air-handling fans on the surface. The mine requires the distribution of sufficient fresh air through the underground openings and work stations to maintain a safe and healthful atmosphere. The quantities provided by the WIPP underground ventilation design exceed those quantities required by both state and federal mine regulations.

To assure continuous and adequate ventilation flows, a mechanically driven system is required. This system is designed to provide sufficient air at the extremities of the longest conducting airways under the worst-case combination of pertinent parameters (i.e., detrimental natural ventilation, air properties, and friction losses). Calculations supporting the design are in Addendum A.

A prime requirement for the underground ventilation design was to devise a means of separating the airflow into two streams, one dedicated to supporting construction efforts and the second for supporting waste storage. A four-entry system that provides the required ventilation separation is shown on Drawings 94568-A5 and 94570-A5. Typical ventilation control and separation structures are shown on Drawing 94572-A5.

The ventilation system was analyzed as a system of fixed airways; prior to starting the analysis, the following criteria and assumptions were established:

a. The minimum airflow velocity in a storage room would be 50 fpm.

b. The minimum airflow velocity in any room under construction would be 100 fpm.

c. Storage operations in two rooms on each level would be occurring simultaneously.

d. Construction activities on two rooms on each level would be occurring simultaneously.

e. Flow friction factors were selected based on experience in operating mines with similar airways and wall roughness.

f. Maximum leakages were assigned to ventilation control structures.

g. Upcast flow quantities were set for the TRU and RH shafts.

The results of the analysis, shown schematically on Drawing 94572-A6, indicate that a total fresh-air quantity of 425,000 cfm is required for underground ventilation.

Ventilation air exits the underground working through four paths; namely, the TRU-RH vent shaft (227,500 cfm), construction vent shaft (168,000 cfm), the TRU waste shaft (9,500 cfm), and the RH waste shaft (20,000 cfm). The air from the TRU-RH vent shaft enters the Mine Storage Filter house on the surface where it flows through a prefilter, a medium efficiency filter, and three HEPA filters before it reaches the biosphere. The exhaust from the RH and TRU waste shafts passes through the filter system in the surface buildings. The construction shaft exhaust is not filtered prior to release.

4.1.2 SURFACE VENTILATION SYSTEMS

Surface facility ventilation systems are depicted in flow diagrams 94540-M1, 94541-M1, 94543-M1, 94547-M1, 94550-M1, and 94551-M1. All radwaste handling facilities are maintained at negative pressures with respect to grade level ambient atmosphere. These negative pressures aid in confining any contamination to a cleanable controlled environment. The static pressure within each separate functional area is continually monitored and automatically controlled to ensure airflow from the least hazardous to the more potentially hazardous areas.

Exhaust Stacks. The high-velocity-jetting, tall-exhaust-stack design is used at the WIPP in lieu of the very low-velocity, low-silhouette-type stack to better dilute any accidentally released contamination. This eliminates the need for HEPA-filtered fresh-air intakes that require higher fan hp (energy), maintenance and initial cost.

Tornado Dampers. Both exhaust and supply air systems are protected from tornado-induced sudden and extreme pressure changes by tornado dampers.

HEPA Filter Banks. The exhaust air HEPA filter arrays serving the radwaste handling areas each typically contains a fire abatement section, two medium-efficiency filter banks and three HEPA filter banks, all in series. An inlet and outlet damper manifold, and a high-efficiency vortex damper-controlled fan section make up the balance of the system.

The fire abatement section consists of a perforated metal static plate, water-sprayed (automatic and manually controlled) wire-mesh prefilters and air-washer-type eliminators. The drains serving all filter sections are connected to the liquid radwaste system. The primary purpose of the fire abatement section is to protect the HEPA filters by arresting sparks, smoke, and debris while simultaneously cooling the hot gases.

The two medium-efficiency filter banks have different efficiencies and are used to remove most airborne particulate so that HEPA filter replacement intervals can be extended.

Two of the three series HEPA filter banks ensure containment of any design-basis accident. The third bank offers protection during normal filter changing and in the event one of the banks should be breached by accident. The first stage HEPA also has manually controlled sprays for cooling. Between all filter stages are normal hazard pendant sprinklers.

An individual airlock for each component section provides access for maintenance, filter changing, and integrity testing. These airlocks have marine-bulkhead-type doors and all-welded seams and fittings for airtight sealing and cleanup ease. The inlet damper manifold permits the exhaust air to be diverted to the standby filter module(s) (see HVAC flow diagrams) without service interruption. Also included in this section is a backdraft damper that prevents a flow reversal. The outlet damper manifold diverts the exhaust air to the standby fan module without service interruption.

The two damper manifolds described above in conjunction with both normal and vital electrical power supplies and multiple controls provide sufficient operating alternatives to enable uninterrupted exhaust air service. The high-efficiency, vortex-dampered fans are controlled by static pressure controllers designed to maintain constant flow through the filter unit.

4.2 ELECTRICAL SYSTEMS

4.2.1 POWER SYSTEMS

The energy requirements of the WIPP facility were analyzed in the Site Energy Study, Addendum D of Section 5. Most energy is brought to the site as electricity; natural gas is not used as a fuel.

Electrical loads are listed in Addendum E, Electrical Load Summary, and are divided into two classes, normal and vital. Normal loads are those not considered to be related to the maintenance of radiological barriers or safety systems. Power to the normal loads is furnished from the utility system with no backup source. Vital loads are fed from the utility system under usual conditions and from site standby generators when utility power is not available.

As a vital load subsystem, uninterruptible power supplies (UPS) furnish power to systems that cannot be off for the time required to energize the standby power system.

4.2.1.1 Off-Site Source Distribution--Electrical power is provided by the Southwestern Public Service Company through a 115-kV transmission line. As shown on the vicinity map, Drawing 94532-C1, the line originates at Southwestern Public Service Company's Potash Junction substation. The total transmission distance from Potash Junction is ~25 miles. The transmission line terminates in a 115/13.8-kV, 30-MVA transformer in the WIPP switchyard.

4.2.1.2 Normal Power System and Distribution--The power system feeders, ducts, manholes, substations and switching and distribution network are as shown in the Overall Electrical One Line Diagram (94555-E1) and the Site Plan Electrical Utilities Drawing (94556-E1). Power from the 30-MVA transformer at the site switchyard is routed underground to the Emergency Power building prior to distribution to site facilities. Switchgear in the Emergency Power building consists of two assemblies of 15-kV air circuit breakers, one to supply normal loads and the other vital loads. Cable in buried nonmetallic duct encased in concrete carries power at 13.8 kV to:

TRU Waste facility
RH Waste facility
Hoist building
Mine Vent Filter building
Administration building
Man/Material building

Suspect Waste/Laundry building
Construction vent exhaust fans
Water tank and pumps, west
Water tank and pumps, east
Mine, upper level
Mine, lower level

Most substations at these locations are double-ended, being supplied from two independent lines from the Emergency Power building. The local substations reduce the 13.8-kV power to either 4160 and/or 480 V for use. The electrical load summary, Table II.4-2-1-1, lists the loads supplied by each substation.

Electrical power is taken underground through three circuits; two of these enter the mine via the Man and Material shaft, while the third enters via the Construction Ventilation shaft. Any one of these three circuits, through transfer switching, can supply the power necessary for selected underground operations.

4.2.1.3 Standby Power System and Distribution--Vital loads are those considered necessary to maintain the facility in a safe shutdown condition during outages of normal power. Table II.4-2-1-1, Electrical Load Summary, calls out the vital loads. Standby power for distribution to vital loads is generated onsite by units located in the Emergency Power building. Three generators are used, each rated at 2500 kW, at 0.8 power factor, generating three-phase power at 13.8 kV. The generators are equipped with suitable voltage regulating and adjusting equipment to permit operation of the vital standby loads on this source of power. The generators have the following accessory equipment:

Direct-driven exciter
High-speed voltage regulator
Exciter field rheostat
AC voltmeter with transfer switch
AC ammeter with transfer switch
Power meter
Frequency meter
Undervoltage relay
Synchronizing meter
Synchronizing relay
Reverse power relay
Overcurrent relay

The standby generators have local controls but start automatically upon loss of normal power or excessive under-voltage conditions. A preselected unit starts first and the remainder pick up and synchronize onto the generator bus as required.

TABLE II. 4-2-1-1

Electrical Load Summary Sheet

Description	Connected Load (kVA)	Anticipated Normal Demand (Site Supplied by Commercial Power) (kVA)	Anticipated Emergency Demand (Site Supplied by Standby Generators) (kVA)
RH Waste Bldg. (Vital)	570.1	339.9	339.9
(Normal)	1310.4	1024.5	
TRU Waste Bldg. (Vital)	774.3	477.2	477.2
(Normal)	1552.9	1280.8	
Administration Facility (Vital)	272.7	145.1	145.1
(Normal)	575.7	575.7	
Mine Construction Fans (Normal)	446.7	446.7	
Man/Material Bldg. (Normal)	172.2	172.2	
Storage Vent Filter Bldg. (Vital)	695.2	695.2	695.2
(Normal)	128.4	128.4	
Suspect Waste Laundry (Normal)	187.3	119.6	
Mine Hoist Bldg. (Vital)	1448.5	1448.5	724.3
(Normal)	2542.0	2542.0	
Water System Pumps (Vital)	563.6	418.4	418.4
Mine Substation			
Upper level (Vital)	370.0	185.0	185.0
(Normal)	3864.4	3864.4	
Lower level (Vital)	1946.4	1751.4	1751.4
(Normal)	3864.4	3864.4	
Standby Generator Bldg. (Vital)	350.3	125.8	268.0
Surface Salt Conveyor	336.0	336.0	
Vehicle Maintenance Facility (Normal)	43.8	43.8	
Warehouse Shops (Normal)	165.5	165.5	
TOTAL	22,180.8	20,150.5	5,004.5

A 2.5-MW load bank is provided to permit periodic testing of the generating units under load. Synchronizing and paralleling of two units each at 50-percent load is possible. The load bank circuit breaker automatically trips on loss or undervoltage of normal power.

4.2.1.4 Secondary Distribution System and Substations--

Surface. One-line diagrams are included in the descriptions of individual site facilities. These diagrams show the switchgear, motor-control panels and voltages for each secondary load. The majority of substations are double-ended, being supplied by two sources with each feeding approximately half the load on the bus. The transformers are equipped with air-break-fused disconnect switches and are of the dry type, rated as shown on the one-line diagrams. The transformers are enclosed in weather-proofed housings and mounted on concrete pads and provide power at secondary voltages of 4160, 227/480 and 120/208. Motors rated at 300 hp and larger are powered at 4160 V. Motors rated at less than 300 are generally powered at 480 V. All motors rated at 100 and larger utilize reduced voltage starting.

A double-bussed motor control center and power panel are located within each building. The panel provides 277/480 V power to the building use points. In addition to providing 277/480 V power to fixed loads, convenience power is supplied to work areas through step-down transformers and panel boards. Details of the load breakdowns are provided in Table II.4-2-1-1, Electrical Load Summary, and Addendum E.

Mine. Power transmission losses in the mine are minimized by maintaining a transmission voltage of 13.8 kV to portable load centers placed near the work areas. As the construction and storage operations progress, the load centers will be moved and permanent distribution lines and junction boxes installed at appropriate locations. The final voltage levels are 4160 V for the mining machines and 208/120 V for lighting, repair and maintenance tools, and 480/277 V for conveyors, transfer cell and shop areas.

4.2.1.5 Receptacle Systems--120/208 V, 1-phase and 3-phase receptacles sized to the work being accomplished are provided in all facilities. 480-V, 60A, 3-phase receptacles are provided in the TRU and RH buildings in welding areas. 120-V receptacles are provided in all office areas, lobbies, and restrooms and in areas in which portable equipment may be used. In office areas or large open areas in which movable partitions are used, underfloor ducts and raceways are installed.

4.2.1.6 D-C Power Supply--Several independent d-c power systems are utilized at WIPP. For example, 125-V dc controls the 13.8-kV breakers that distribute both normal and emergency power. D-c power is supplied from an independent battery power supply system for this service. Other systems that use d-c power are the emergency generators and the central control system, both of which have self-contained battery systems.

4.2.1.7 Regulated Power System--Regulated power is supplied on an individual basis to those loads, or groups of loads, requiring special treatment. Special requirements of the computer system are met by the computer UPS system.

4.2.1.8 Experimental Area--Power requirements to the experimental area are estimated at 2.2 MW. All but a very small portion of this power is used to supply power to heaters that simulate the thermal output of waste containers. As many as 200 heater arrays, each drawing 10 kW of power, are emplaced in the 20-acre experimental area in the RH horizon. Each array consists of one to four heating elements fed by single-phase 480-V circuits.

4.2.1.9 Uninterruptible Power Supply (UPS) System--The UPS systems are of the battery-inverter type. Separate systems, sized at 30 kW, are provided in the RH Waste facility, TRU Waste facility, Administration facility and the mine. These systems are maintained in a fully charged condition at all times and are capable of being charged from either the normal or standby power sources. Time duration of operation of most systems is 4 hours, to allow start-up of the standby generating system. The UPS for the computers provides the required regulated power output for the computers. UPS systems are shown on the one-line diagrams for the RH, TRU and Administration buildings.

4.2.2 LIGHTING SYSTEMS

Exterior. Exterior lighting is provided for roadway and perimeter areas by high-pressure, 480-V sodium-vapor fixtures mounted on poles. Obstruction lighting is provided for the surface structures in accordance with Federal Aviation Administration regulations.

Building and Facilities. General lighting is provided in each room, shop and area at levels that permit performance of normal tasks without additional light from portable fixtures. Lighting in the offices and laboratories is by fluorescent fixtures stem-mounted at ceilings. Lighting for all other areas inside the buildings is by high-pressure sodium-vapor fixtures solidly mounted to ceilings. Lighting voltage is 277 V.

Emergency. Emergency lighting is provided in each building that houses personnel to permit safe movement out of the building during power outages. These lights operate from a d-c battery inverter power system and provide nominal illumination. Exit signs within buildings are of the self-energizing type.

Typical lighting levels within the facility are listed in Table II. 4-2-2-1.

4.2.3 COMMUNICATIONS SYSTEMS

4.2.3.1 Telephone and Radio Systems--Telephone service is provided by General Telephone Company of the Southwest; it originates from General Telephone Company's facilities in the Carlsbad, New Mexico, exchange, and terminates in the WIPP Administration facility. The total off-site cable length is 40 miles (routing is shown on Drawing 94532-C1). Telephone service at the site is routed through a switchboard located in the Administration facility where an operator controls incoming and outgoing calls. In-plant telephone communications and placement of outgoing calls is handled through an equipment rack located in the electrical equipment room. The telephone communication system interfaces with the PA and intercom systems described in Section 4.2.3.2 to provide a complete communication system. The telephone system provides for communication between the Administration facility and the following:

TRU Waste facility
RH Waste facility
Man/Materials building
Warehouse/Shops building
Suspect Waste/Laundry building
Vehicle Maintenance facility
Hoisthouse facility
Man/Materials Headframe
Mine Storage Filter building
Emergency Power building
Site Entrance gatehouse
Mine Shaft stations

Instruments are located in each of the above on the basis of projected occupancy. Telephone cabling is routed through the instrumentation and communication ducts as shown on Drawing 94556-E1.

TABLE II. 4-2-2-1

Typical Lighting Levels*

TRU Waste Facility	Footcandles
Inventory and Preparation	30
Overpack and Repair	50
Locker Rooms	10
Offices and Labs	70
Corridors	10
Air Locks	10
Equipment Room	20
Conference Room	50
RH Waste Facility	
Cask Preparation	50
Upper Transfer	50
Cask Decontamination	50
Offices and Labs	70
Control Room	70
Corridors	10
Locker Rooms	10
Air Locks	10
Cask Unloading/Loading Area	20
Administration Building	
Offices and Labs	70
Computer Room	70
Conference Room	50
Cafeteria (Dining Area)	50
Kitchen	50
Restrooms	30
Dispensary	70
Emergency Power Building	
Office	70
Switchgear and Generator	20
Man/Materials Building	
Control Room	70
Lamp Repair Room	70
Cage Loading Area	30
Receiving and Storage Room	20
Office	70
Locker Rooms	10
Mine Storage Filter Building	
Filter Wash Area	20
Filter Rooms	10
Hoist Buildings	
Control Room	70
Machine Room	30
Offices	70
Warehouse/Shops	
Offices	70
Shops	50
Storage Room	10
Site Entrance Gatehouse	20
Vehicle Maintenance Facility	50
Parking Lots	2
Perimeter Lighting	0.8

*Footcandle levels listed are maximum overall design limits--after consideration for task lighting and turnoff of unused fixtures the actual room illumination levels will be less.

Radio communication is also provided for the WIPP facility. Radio systems are located in the operations control area of the Administration facility to provide mobile and portable two-way communications for facility vehicles and security guards. Transceivers are also provided to maintain contact with civilian, defense and military agencies and aircraft. An AM/FM antenna system is provided at the Administration facility for maintenance of radio communications.

Underground, highly mobile equipment such as trucks, personnel carriers and the waste-handling equipment are equipped with radios. These radios are specially designed for underground use. Hard-line antennas are provided throughout the main panel access entries to overcome transmission problems encountered underground.

4.2.3.2 Public Address and Intercom Systems--Both local and master public address (PA) systems are provided. Local systems are located within the following facilities:

Administration facility
TRU Waste facility
RH Waste facility
Warehouse/Shop building
Man/Materials building
TRU-RH Hoisthouse
Mine storage horizons

Each local system has a master page station to control communications within the individual facility. The master station is typically located in the building lobby or central office. The master paging system is controlled from the operation control center in the Administration facility and is connected to each of the above local systems as well as to PA speakers in the following buildings and areas:

Man/Material Hoisthouse
Suspect Waste/Laundry building
Vehicle Maintenance facility
Water Pumphouses
Sewage Treatment plant
Emergency Generator building
Site Entrance Gatehouse
Exterior Site Areas:

- Truck Park
- Sewage Effluent pond
- Suspect Waste pond

Railcar Storage/Park
Man/Materials Shaft Headframe
Vehicle Gas Station

All PA systems have talk-back capability with handsets located at the speakers. Local systems are connected to the operations control master "all call" station that has tone generators to sound "immediate evacuation" and other emergency signals over all (or selected) speakers. System changeover amplifiers assure maximum system reliability.

Communications systems in the mine and shaft areas use specialized intercom systems commercially available from telephone companies. These systems are capable of operating in the harsh underground environment. Each work station phone has both an audio and visual means of paging. Separate circuits connect individual operations, such as the TRU storage operations. The storage rooms, the TRU unloading station and the loading station at the TRU shaft collar will comprise one circuit. Another circuit connects the construction working place with all conveyor stations and the shop. Separate circuits allow simultaneous communications for normal operations. Cross circuitry is also provided for communicating between dissimilar operations and for simultaneous communication to all stations under emergency conditions.

Shaft communications are basically the same as those in conventional mines. Audible and visual signaling between the hoistman, the shaft conveyance and each level station are via electrical circuits.

4.2.3.3 Closed-Circuit Television (CCTV) System--CCTV fulfills three requirements at the WIPP facility; one system will be used in security operations for monitoring perimeter fences and buildings, a second use will be for various waste-handling operations, both on the surface and underground and a third use will be for safety-related items. Examples of waste-handling operations are the shipping cask unloading operations, the operations in the decontamination cell, and the loading and unloading of the RH hoist.

4.2.4 ALARM SYSTEMS

4.2.4.1 Intrusion Alarm System and Distribution--As specified in Part II, Section 4.3. the intrusion alarm system uses perimeter intrusion alarms, door intrusion alarms in all buildings, and motion detectors in vital areas. Wiring for the intrusion alarms and motion detectors is in metal conduit or equivalent protection.

Service panels for security systems of a vital area are lockable if located outside the vital area. Disclosure of design and operational details of security devices is avoided and will be submitted to regulatory agencies on a proprietary basis in accordance with U. S. ERDA Regulatory Guide 1. 17. Data from these alarms are received in the Security Operations Control Room and may also trigger outside alarms.

4.2.4.2 Fire and Evacuation Alarm System--Each building and certain areas of the mine have an independent local fire alarm system that transmits a signal to the fire-alarm monitoring system in the central monitor control rooms of the Administration facility through a central data gathering/transmitting device. Figure II. 4-2-4-1 is a block diagram for a typical building fire alarm system. Refer to Section II. 4. 2. 5 for a description of the central monitoring system with which the fire alarm system interfaces.

Activation of a smoke detector, heat detector, pressure switch or manual pull station in a detection loop is sensed by a locally mounted panel that transmits a signal to the system's central processing unit (CPU). The CPU then starts any assigned event-initiated commands. The alarm point is displayed in the central monitor control rooms on fire command system annunciation boards that are separated from other nonfire-related boards. Alarms are both visual and audible and continue until acknowledged by the operator. An alarm condition also automatically initiates the sounding of a fire-alarm evacuation signal in the fire zone. The control-room operator can interrupt the alarm tone to make special voice announcements. An all-call capability makes it possible to alert and advise occupants of any part of the building or any other area of the site.

4.2.5 CENTRAL MONITOR AND CONTROL SYSTEM

The central monitor and control system, shown in Fig. II. 4-2-5-1, provides facility monitor personnel with data from systems and equipment required for normal plant operation, safety-related systems and equipment used in the event of accidents, instrumentation used to monitor site environmental conditions, and instrumentation used to monitor radioactive waste release. Visual and audible indications of alarm functions, as well as a permanent hard-copy record of systems status, are provided in the central monitor control rooms of the Administration facility.

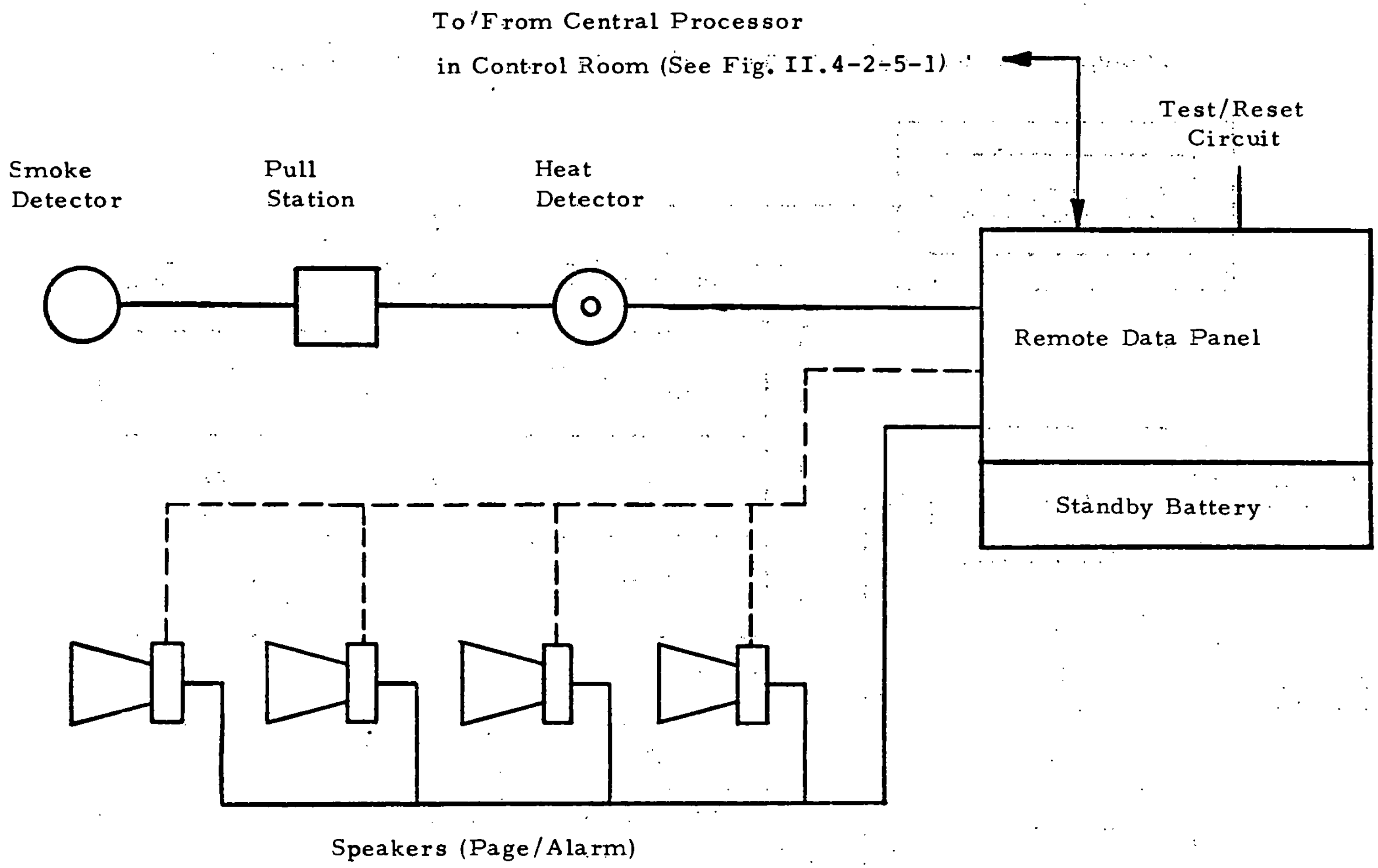

Figure II. 4-2-4-1. Fire alarm system

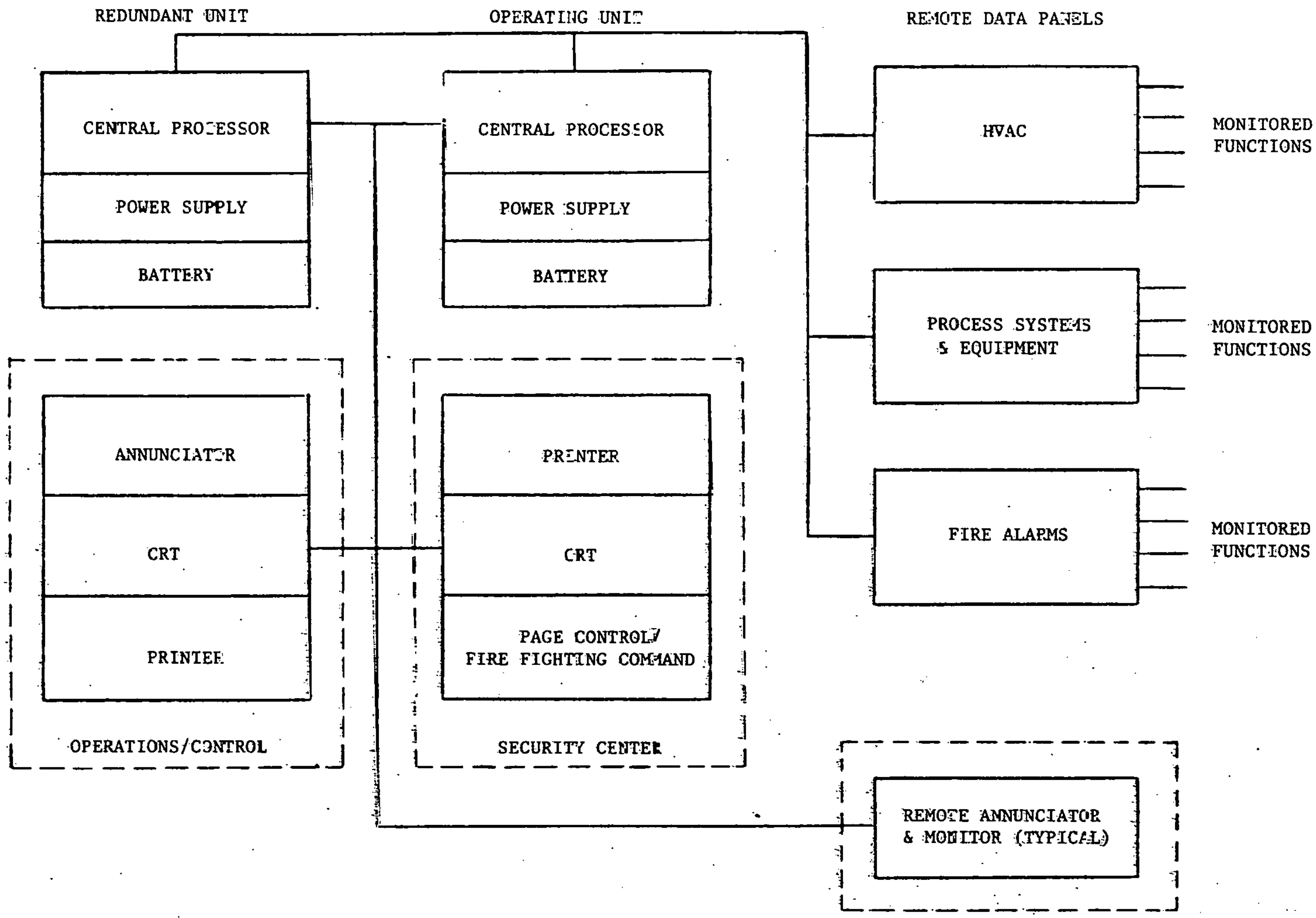

Figure II. 4-2-5-1. Central monitor and control system block diagram

Individual sensors located within a building or area feed output signals through a local data input panel to a central data-processing system. Local monitoring and control of the parameters fed to the central monitor and control system are also available.

The facility monitor in the central monitor control rooms is provided with annunciated alarms, hard-copy printout of systems status on both scheduled and demand basis, and direct in-plant communication capability through the paging system (refer to Section 4.2.3.2). He is also provided with information from the fire-alarm system (see Section 4.2.4.2). The facility monitor has direct communication link to security personnel responsible for monitoring the security and intrusion alarm systems.

Figure II.4-2-5-2 shows an arrangement of equipment that is provided to the facility monitor. Individual sections are modularized, to allow expansion of the present basic system based on the total number of data points ultimately required. Annunciator panels provide visual and audible alarms for system or component malfunctions.

Monitored points are alarmed individually or in groups based on the importance of the component being monitored. Those components related to the safety of the facility, malfunctions of which might release radioactivity from the facility, are alarmed individually. As an example, the mine storage exhaust fans are individually monitored and alarmed for status (on/off), bearing temperatures and flow. Systems of a less critical nature, such as the Man/Material building ventilation system, are group-alarmed to indicate malfunctions so that maintenance personnel can be sent.

A cathode-ray tube (CRT) provides the facility monitor with the ability to demand and display data, issue instructions, and retrieve stored information. The CRT also provides visual and audible alarm functions including preprogrammed data on the type of alarm, location, and other pertinent information. The CRT provides logging functions such as:

All-point log
Single-group log
Alarm summary log
Status summary log
Totalizer log
Energy management log
Programmed data logs

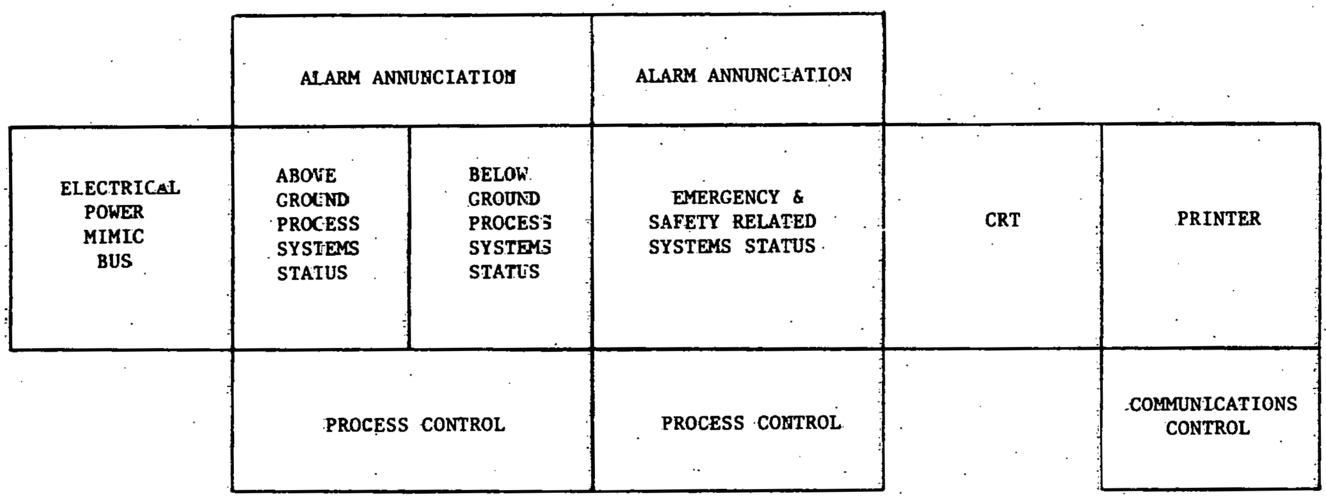

Figure II.4-2-5-2. Central monitor & control system display functions

A printer provides hard-copy records of the logs, alarms and other data displayed to the facility monitor on the CRT. The intercom module and paging controls with desk microphone provide the facility monitor with the previously mentioned ability to communicate throughout the facility.

In addition to monitors at the central monitor control rooms, selected systems are also monitored at local stations to provide local status checks and immediate response to alarms. Critical systems monitored include the HVAC systems in the RH and TRU Waste facilities, the mine storage exhaust system in the Mine Storage Filter building, the HVAC and radwaste process systems in the Suspect Waste/ Laundry building, the cask cooling and canister decontamination systems in the RH Waste facility, and the emergency generator operation monitor system.

4.2.6 DATA PROCESSING SYSTEM

The WIPP requires a computing system that can provide a wide range of data-processing needs on a 24-hr basis indefinitely. The computer system consists of computers and peripheral equipment, with extensive software and communications capabilities. Hardware and software should be very reliable and easily expandable. The system processes a wide mix of application programs and languages and also adapts to daily computer processing load changes. The computer manufacturer or WIPP operating contractor must provide continuous on-site maintenance and guarantee minimum repair time. The system handles batch, interactive, and real-time data processing requirements.

Batch Processing. Batch processing requires limited response time and no programmer or outside intervention. Many business or scientific applications use batch processing. These applications can require large amounts of computer memory and computer time but because of their low priority are usually processed during nonprime time.

Interactive Processing. Interactive processing requires service at frequent but intermittent intervals. Development and testing of computer programs is best done at interactive terminals. Timesharing permits many people at their own terminals to interact with the same computer through small-time intervals to create and run individual programs. Large storage disks for data storage and a high-speed printer for large computer printout all serve computer users. (See Addendum M for additional detail.)

Real-Time Processing. Real-time processing requires immediate response from the computer system. Fast response is required when a real-time event in the form of an interrupt from a high-speed communications device signals the computer that it is ready to send data. Other real-time events are clock-driven; this real-time event is less time-critical than the first and is assigned a lower software priority and a slower response time. In either case, real-time events always imply the need to respond rapidly and are assigned higher priorities than interactive or batch-processing tasks.

WIPP computing requirements can best be resolved by following a distributed network scheme; that is, a large central supervisory minicomputer interfaced with several smaller minicomputers and microprocessor systems. The large central computer, located in the Administration building, is linked via high-speed communication lines with the other minicomputers, microprocessors and terminals. The smaller minicomputers monitor and process most real-time events such as in-situ experiments and stored wastes data, loop-badge systems, meteorological data, ventilation parameters, radiation levels, and alarm and control systems.

The large-capacity storage devices of the central computer provide permanent data storage. Intermediate storage of the real-time data permits more efficient use of the communication links to the central computer and provides continuous processing when the central computer is down. Most of the data communications load is handled by the small computers, leaving the central computer free to coordinate operations for the entire computer network.

The computing system can modify the system parameters that determine how much computer time each of the three general data processing types receives from the central computer, with real-time monitoring tasks receiving the highest priority at all times.

The WIPP computing system requires:

- Network software
- Data communication protocols and software
- Software security and accounting protocols
- Industry-standard high-level languages for scientific (BASIC, FORTRAN) and business applications (COBOL and Report Generation)
- Compilers for high-level languages
- Assemblers for machine-level languages and loaders to link and convert both high-level and machine-level programs into an executable format

Utility routines include a text editor, on-line program debugger, file maintenance capabilities, libraries for commonly used mathematical and input/output subroutines, etc. Documentation and training courses for the computer operating system from a system to user level should be available. System software update support from the computer manufacturer should be reliable and responsive with system consultants available when needed.

4.2.6.1 Data Bases--Typical real-time data bases include:

- Time-based parameter data such as temperature and strain-gage values from the large thermal field experiments
- Time-based parameters from the TRU and RH horizons
- HEPA filter parameters
- Meteorological parameters
- Radiation measurements from the HVAC system
- Radiation history for WIPP/ waste-handling personnel
- Payroll, plant engineering inventory, and loop-badge data bases

As radioactive material is received, unloaded, and stored, inventory data bases are produced that include type, identification number, radioactive and nuclide data and shipping data as well as WIPP storage location. Data bases that are subjected to retrieval analysis and are not too large are allowed permanent storage on the mass-storage devices of the central computer. Very large data bases require permanent storage on magnetic tapes and are copied into a temporary disk storage area whenever computer analysis is required.

All data bases are updated at regular intervals and copied to magnetic tape(s) to provide a permanent data library and to prevent saturation of the mass storage devices.

4.2.6.2 Data Collection Systems--The most important data processing requirement for the WIPP facility is to monitor and collect real-time data with various minicomputers and microprocessors located about the WIPP facility. Each computer system includes a local terminal for system and application program loading, execution and restart capabilities. A computer system may also be interfaced to process Input/Output (I/O) subsystems. Monitoring real-time events over a wide area, especially below ground where experiments are run on the RH horizon, requires using remote-process I/O subsystems. These subsystems can be physically separated from the computer by distances up to a mile with a single coaxial cable providing the high-speed interface link.

A minicomputer or microprocessor system with remote I/O subsystems is needed to collect real-time data from in-situ experiments at the RH and TRU horizons (see Section II. 2. 3. 3). The large number of sensors requires two minicomputer or microprocessor systems with several remote I/O subsystems. Two small computer systems are needed to process the large number of sensor readings and provide continuous real-time monitoring if one computer is down because of the possibility of computer malfunction.

Additional minicomputer or microprocessor systems are required for the meteorological station(s), radiation lab system, the central monitor and control system and the HVAC monitoring system as well as central supervisory computer system located in the Administration facility.

4.2.6.3 Scientific and Business Systems--The WIPP computing system is subjected to interactive batch and real-time data processing demands. Interactive processing via the various remote terminals provides a wide range of scientific and business applications. Typical interactive processing includes entering new waste inventory data, editing and error correction of the new data, merging the new data with the existing data base and dumping the new data base from mass storage disk to magnetic tape for backup.

Batch processing jobs are entered via a remote terminal or from the central computer systems card reader in the Administration facility. Typical batch processing jobs include statistical analysis of geological and meteorological data, analyses of ventilation systems, fault tree analyses, rock mechanics analyses, modeling for the movement of radionuclides in the biosphere, and risk assessments for repository conversion decisions.

Additional processing requirements are business oriented. Typical business processing jobs include payroll for the WIPP facility personnel, report-generation capability, inventory analysis and accounting. Large-batch computer programs are usually completed during second and third shifts when interactive processing is minimized.

4.2.6.4 Remote Terminals and Locations--The central supervisory computer system in the Administration facility provides interactive processing via remote terminals located both above and below ground. Remote terminals are located in the TRU Waste facility, the RH Waste facility, the underground computer area, the central monitor control rooms, and at the access control area in the Administration facility.

4.2.7 INSTRUMENTATION SYSTEMS

4.2.7.1 Environmental Surveillance--Environmental measurements at the WIPP site are required to acquire data on meteorology, air quality, and seismic phenomena. The data are used to establish baseline values, to determine the impact of construction and waste disposal operations on the environment, and to document operating conditions at the WIPP. Also, indications of severe conditions may result in restricting some WIPP operations.

Before completion of the WIPP surface facilities, meteorological and air-quality data are collected at a temporary station located ~one-half mile southwest of the site entrance. During the operational phase, these sensors are relocated within Area B to centralize data collection locations. Meteorological data collected include wind direction, wind speed and temperature at 10- and 40-m elevations. Measurements of precipitation, barometric pressure, dew point and incident and reflected shortwave and longwave solar radiation are also planned.

Surface air-quality measurements include monitoring of the following pollutants: O_3, CO, SO_2, NO, NO_2, H_2S, all sulfides and total hydrocarbons. Chemical analysis of particulates from high-volume air samples include total weight particulate, Si, Fe, Al, Na, K, Ca, Mg, SO_4, and Cl. Mineralogical analyses are also performed.

Seismic data and analysis are required to provide estimates of anticipated earthquakes in the region and the resultant ground motion in the vicinity of the WIPP. Several years of data taken under ORNL and Sandia contracts from a seismograph station in southeastern New Mexico have been analyzed. Future seismic monitoring for the WIPP may involve continued operation of this station.

4.2.7.2 Experimental Area Instrumentation--Although the WIPP experiment matrix is not yet well defined, it is clear that a large instrumentation effort is required in the experimental areas. Some measurements use techniques with mechanical indicators that are hand-recorded (i.e., dial indicators on extensometers), but most result in electrical outputs with real-time recording. For the real-time recording, estimates have been made as high as 5000 channels.

Thermal field and rock mechanics experiments require many measurements of temperature, stress, strain and displacement. The large heater arrays used to generate thermal fields require a well-regulated, reliable power system with variable output. Power requirements as high as 2.2 MW are predicted.

High-level waste experiments require temperature and pressure measurements. Also investigated with these experiments are phenomena such as brine migration, radionuclide migration, offgas generation and movement of waste canisters. Techniques for real-time monitoring of these phenomena are being investigated.

Most data to be recorded have very low-frequency content. This fact, and the large number of data channels to be recorded, make digital recording and processing desirable. With a digital system, data compression techniques reduce the number of data points stored. Also, limits are set and checked against the data to call attention to out-of-range conditions or inoperative channels.

Most of the signals are in analog form from transducer through signal conditioning to remote I/O subsystems where analog-to-digital conversion takes place. The digital stream from the remote I/O unit is fed to computer facilities for storage and output to the computer peripherals.

Transducer types include thermocouples, strain gages and potentiometers. Selection of these transducers requires consideration of material properties, operating temperatures and radiation environment.

Signal conditioning modules provide

a. amplification for low-level signals,
b. bridge completion networks,
c. calibration circuits,
d. thermocouple (TC) reference junctions,
e. system checkout points,
f. transition points to convert from thermocouple cables or small signal cables to large multipair cables, and
g. excitation to transducers that are not self-generating.

4.2.7.3 Radiation Monitoring--A radiation monitoring program is required at the WIPP site to assist in maintaining occupational exposures as low as is reasonably achievable, and to determine any impact on the environment. Specific details of the monitoring program depend on facility locations and work to be performed, and on prevailing meteorological conditions.

Environmental Monitoring. An environmental monitoring program is maintained throughout the operational phase to measure WIPP contributions to off-site exposure by direct radiation, airborne radioactivity, radioactivity deposited in the environment, and radioactivity in biological media. The location of sampling stations, the frequency of sample collection, and the biological media to be sampled are determined by factors such as meteorology, topography, hydrology, land use, and the existence of potential biological pathways for the exposure of man.

A preoperational monitoring program will be initiated about two years before radioactive material is to be introduced into the WIPP to identify the biota to be sampled in each exposure pathway and to identify prevailing meteorological conditions. This program is flexible enough to meet all needs of all phases of facility operation.

Direct Radiation Monitors. Direct radiation monitors located throughout the underground and surface facilities assess the radiological condition of WIPP operations and are placed so that occupational radiation exposures can be maintained as low as reasonably achievable. Detector ranges are selected according to the work to be performed and exposure rates anticipated. All direct radiation monitors are monitored by the facility's computer and will alarm locally and in the central monitor control room.

Air Sampling Monitors. Facilities in which radioactive materials are handled are monitored for airborne radioactivity by monitors preferentially located in high-activity areas for earliest indication of airborne radioactivity. The type of air monitor used depends on the type of materials handled within a particular facility. All air monitors give a local alarm and selected monitors read out in a central monitor control room.

Discharge Stack Monitors. All potential gaseous discharge points are monitored continuously to determine the concentration of radioactive materials in the effluent stream. Information obtained from the stack monitoring program is used to calculate potential exposures to off-site populations. All data received from the stack monitors are recorded by the facility's computer, with an alarm in the central monitor control room.

Liquid Radwaste Monitors. All waste streams carrying potentially contaminated water are monitored continuously before discharge to the environment to preclude contamination of aquifers in the WIPP area. Data from the liquid monitors are recorded by the facility computer, with alarms in the central monitor control room.

Personnel Dosimeters. Radiation exposure to personnel working in areas in which radioactive materials are handled is monitored with thermoluminescent dosimeters. These dosimeters are incorporated into the facility security badge.

Self-Monitoring Stations. Hand-and-foot monitors and self-monitoring survey instrumentation are located in all waste-handling areas.

Portal Monitors. Portal monitors are located at the exits of all waste-handling areas and into security operations area B corridor to monitor personnel for contamination.

4.2.7.4 Loop-Badge Monitoring--A self-energized credential system (loop-badge system) has been developed by Sandia to detect automatically the passage of personnel into or out of controlled areas by means of a coded loop badge. The use of the loop-badge system for access control is discussed in Section 4.3. The loop badge is activated by the presence of an alternating magnetic field contained within a portal and responds by transmitting a stored code, along with necessary synchronization and parity bits, to a receiver detection and decoding. After decoding, the received identification word is available for use either by a computer or by visual display to Security personnel.

The loop badge appears to be similar to badges worn by individuals in other typical controlled or secured areas. However, this particular badge incorporates electronics containing a unique identification code plus a thermal luminescent dosimeter. The electronics are normally in the "off" or passive state but when located within the portal become active and transmit a unique code. To optimize signal-to-noise ratios and reduce the costs associated with individual cables from the transducers, the signal conditioning is located close to the transducer.

Loop-badge portals are located within the facility as described in Section 4.3 and are incorporated with radiation portals wherever possible. These portals will provide information at any time concerning the presence of employees and visitors within certain sensitive areas of the facility and provide a record of all personnel in Area B. These data are useful in an accident situation and particularly in the event of a mine accident.

4.2.7.5 Laboratory Instruments--Laboratory instruments are required at the facility for radiological and air-quality measurements.

TRU Waste Counters. Instrumentation at the WIPP facility includes instruments for assessing the exterior contamination levels of waste containers and the surfaces of the transporting vehicles. These surveys are accomplished using a combination of portable instruments and surface swipes. The swipes are counted using shielded counters in conjunction with scalers. These swipe counters are located conveniently throughout waste-handling areas. Also, incoming TRU waste shipments are screened to ensure that no large concentrations of TRU material are inadvertently stored.

Site-generated solid waste shipped off-site for treatment may require instrumentation to assay the contents of various types of waste containers. This assay may include the identification and quantification of the radionuclides present within the container.

RH Canister/Cask Counters. Portable instruments and surface swipes are used to survey casks in which high-level wastes have been transported to the facility. Contamination levels on the exterior of the canisters are assessed by swiping and by analyzing the water used to decontaminate the canister. This instrumentation is shielded to lower the radiation background and increase the probability of detecting surface contamination on the canister.

Central Laboratory Instruments. The central laboratory contains instrumentation to support the waste-handling operations and the experimental program. Instrumentation is versatile enough to analyze environmental samples as well as the high-activity samples anticipated in the experimental program. The laboratory has a complete analytical chemistry capability, with instrumentation to identify and quantify both alpha and gamma-emitting radionuclides.

Air-Quality Instruments. Air-quality measurements to assess the impact of the WIPP operation on the environment require gas chromatography, chemoluminescense, nondispersive infrared and flame ionization instrumentation.

4.2.7.6 Building and Facility Instrumentation--HVAC instrumentation provides input to the central monitoring and control system. Supplemental monitoring for the fire protection system is described in Section 4.2.4. Minor systems such as the Vehicle Maintenance facility compressed-air system are provided with local instrumentation as required. All monitoring will indicate systems operating status and warn of malfunctions. The general philosophy of alarm or status monitoring is to monitor equipment as described in Table II.4-2-7-1. Instruments to perform the functions listed are usually of the types described in Table II.4-2-7-2. All data provided in the tables are of a general nature and indicate the types of instrumentation that may be used.

TABLE II. 4-2-7-1

General Monitoring Philosophy

Item	Functions Monitored
Fan	Motor and Fan Bearing Temperature, Pressure Rise, Motor On/Off
Pump	Motor Bearing Temperature, Motor On/Off, Pressure Rise
Emergency Dampers	Position
Critical Valves	Position
Filters	
Single-Stage	Pressure Drop
Multiple-Stage	Pressure Drop Between Stages
Air-Handling Units	Element-to-Element Pressure Drop and Temperature Change
HEPA Filter Spray	Supply Pressure, Flow
Building Zones	Pressure and Temperature, Reference to Ambient
Cooling Water	Supply and Return Temperatures
Heated Water	Supply and Return Temperatures
Motors	Status On/Off
Refrigeration Systems	Thermostat Settings, Compressor Pressure
Sumps/Ponds	Level
Tanks	Level, Pressure, Temperature
Demineralizers	Radiation Breakthrough
Exhaust Stacks	Temperature, Radiation

TABLE II. 4-2-7-2

Instrument Types

Parameter Monitored	Sensing Units Instrument Type
Motor Bearing Temperature	Thermocouple/Temperature Switch
Pressure Drop	Differential Pressure Switch, Manometer or Diaphragm Sensor
Motor On-Off	Determined From Starter Auxiliary Contacts
Damper/Valve Positions	Position Switches, Relay Contacts
Water Flow	Roto Meter
Temperature	Thermocouple, Temperature Switch
Tank Level	Level Switch, Float or Probe Type
Sump/Pond Level	Float Switch
Zone Static Pressure	Pressure Switch for Alarms Utilizing Manometer or Diaphragm Sensors
Radiation Monitors	

4.2.8 CABLE SYSTEMS

Electrical power cable and instrumentation wiring systems are designed to meet the following general criteria.

- The facility design includes simple methods of cable identification so that safety-related and nonsafety-related cables, as well as redundant safety-related cables, can be identified without consulting reference material.

- Electrical wiring systems and their supporting members servicing safety-related equipment are protected against fire. Cable enclosures, fire-stops at fire barrier walls, floors and ceilings and nonflame-propagating electrical insulation are used in the design of electrical wiring systems to minimize the spread of fire.

- Power and instrumentation cables are separated and/or protected as required to assure noninterference in conducted signals.

- Cabling for safety-related redundant equipment is separated to assure that single failures will not compromise the redundancy.

4.2.9 LIGHTNING, GROUNDING AND CATHODIC PROTECTION SYSTEMS

4.2.9.1 Lightning Protection System--A lightning arrestor is provided on the secondary side of the 30-MVA utility transformer, as shown on Drawing 94555-E1 and is connected to each underground conductor on the incoming side of the 13.8-kV disconnect switch. All buildings are provided with lightning rods installed in accordance with the Lightning Protection Code ANSI C5.1 - 1969 and Underwriters Laboratories Guide UL96A. All communications and instrumentation cables are separated from lightning conductors by at least 6 ft.

4.2.9.2 Grounding System--A grid-type ground system is installed, each grid consisting of a loop of stranded annealed copper wire at least 4/0 AWG in size and completely encircling a building or area, together with a number of cross connections. Copperclad steel ground rods, at least 10 ft long, are driven into the ground at each corner of the loop and at intermediate points to obtain a resistance from each grid to earth of not more than 5 ohms as measured by the "fall of potential" method. The following items are connected directly to the ground grid:

- Alternate outside columns of steel-framed buildings and not less than one-third of all the inside columns of the buildings.

- All metal noncurrent-carrying parts of motors and major electrical equipment.

- The secondary neutrals of all transformers.
- Ground buses of switchgear, motor control centers and instrument panels.

The ground in the mine is common with the surface grid via the grounding conductor in the man and material shaft. Insulated messenger cables distribute this ground throughout the mine, terminating at the grounding bus in the 13.8-kV-load centers.

The grounding system for the emergency power building is independent of the system for the remainder of the facility. A separate grounding system is also provided for radio, communication and instrumentation systems.

4.2.9.3 Cathodic Protection Systems--Cathodic protection systems will be installed on all underground piping and equipment in areas in which active corrosion is found. Areas of active corrosion will be determined by electrical survey. Cathodic protection with rectifiers, galvanic anodes, and/or other current sources will be considered in the final system designs. Insulated joints will be installed to separate equipment and piping electrically from terminal facilities and pumping systems.

4.3 PLANT SECURITY AND ACCESS CONTROL

4.3.1 CONTROLLED AREAS

4.3.1.1 Perimeter and Grounds--For perimeter protection, two areas are considered; an area using normal industrial security (AEC Chapter 2406, Physical Protection of AEC Property), hereafter designated "Area A," and the second area, designated "Area B," which requires tighter security as well as personnel control for health physics and safety reasons, as shown in Drawing 94533-C1.

The following facilities are located in Area A with all other facilities and ventilation vents located in Area B:

A portion of the Administration facility
Employee and visitor parking
Commercial truck and tractor parking
Hold area for railcars
Site entrance gatehouse
Hold area for trucks delivering waste

The perimeter fence around Area A is constructed of 10-ft chain-link fabric with 8 ft above and 2 ft below ground. Three strands of barbed wire on extension arms are included to provide a total fence height of 9 ft above grade. A caliche road for patrol purposes is located inside the fence. Industrial lighting around the fence and within the area is provided.

Area B is completely surrounded by two 8-ft chain-link fences similar to the Area A fence described above, and separated by 10 meters with microwave sensors and caliche road located between the fences. E-field sensors are used as the intrusion sensing system where structures may interrupt the Area B fence line. Closed-circuit television (CCTV) with low light, scanning, and zooming capability are installed in Area B to provide a view of Area A and B grounds. Stationary CCTV is installed to monitor the Area B fence line whenever the microwave sensors are activated.

4.3.1.2 Vital Areas--A list of the vital areas and buildings has been prepared, and the specific design information for these areas will be made available to those having a need to know.

4.3.2 INTRUSION ALARM SYSTEMS

4.3.2.1 Perimeter and Grounds--The perimeter and grounds alarm systems (microwave and E-field sensors in conjunction with CCTV) are described in 4.3.1.1 above.

4.3.2.2 Building Alarm Systems--All buildings have door alarms. Motion detectors are also used in the vital areas.

4.3.3 SECURITY OPERATIONS CONTROL CENTER

A security operations control center is located within the central monitor control rooms. This center provides a central source for receiving data from all the alarm systems and houses controls for monitoring systems such as CCTV. The control center is in a reinforced concrete structure hardened to resist unauthorized entry, and serves as the communication link between the WIPP and outside authorities in case of accidents and/or incidents.

4.3.4 VEHICULAR ACCESS

4.3.4.1 Employees--Permanent car decals are issued to employees for access to Area A only.

4.3.4.2 Visitors--A temporary car pass is issued at the Site Entrance Gatehouse after administrative authorization is issued.

4.3.4.3 Waste Shipments--Waste materials arrive at the Site Entrance Gatehouse by rail or truck. Shipping invoices for all shipments are inspected and verified for authenticity at the Site Entrance Gatehouse before waste transporters can enter Area A. Once inside Area A, the waste transporters (railcars or truck trailers) are parked in predesignated locations and are decoupled from their prime mover (tractor or diesel locomotive). Depending upon the mode of operation of the facility and the origin and type of transporter, the tractor or locomotive either picks up empty transporters for a return trip, waits for empty transporters to be readied for transportation or leaves empty.

WIPP facility prime movers are coupled to the transporters in the A area and provide for all further movement on-site until the empty transporters are returned to Area A for shipment off-site. The site prime mover moves into Area B through the entry portal at the security inspection station of the Administration facility. Transporters are inspected at this point, and their shipping invoices are rechecked. Once inside Area B, the transporter is moved into the waste-handling building or to a predesignated parking/storage space where it remains until scheduled for unloading.

Empty transporters are removed from the waste-handling facility, given a final inspection, and moved to either the parking/storage section of Area A or Area B depending upon the availability of a commercial prime mover for shipment from the site.

4.3.4.4 Outside Contractor Service Vehicles--A temporary gate pass is issued by a guard at the Area A gate after he receives administrative authorization. Every attempt will be made to avoid entrance of nonfacility-owned vehicles into Area B, but when necessary, they will be admitted after a search for prohibited articles.

4.3.5 PERSONNEL ACCESS

4.3.5.1 Employees--Badges or ID cards with the employee's picture are issued for use in Area A. When entering Area B, after personnel identification by a guard, the employee exchanges this ID for a loop badge that includes a radiation dosimeter. The loop badge is used to log the employee in and out of the Area B portal as well as other facilities such as the Man and Material shaft, areas in the mine, and the TRU and RH Waste facilities.

4.3.5.2 Visitors--Visitors are logged and issued a badge at the Site Entrance Gatehouse after administrative authorization is issued. A loop badge is issued at Security Operations if access to Area B is required. Employees or guards escort all visitors in Area B.

4.3.6 PHYSICAL SECURITY PLAN

A physical security plan will be developed by the operating contractor in accordance with U. S. Energy Research and Development Administration policy.

4.4 MINING SYSTEMS AND EQUIPMENT

Variable-height, three-bladed, twin-rotor boring-type continuous miners that cut a cross section 10 ft high by 18 ft wide with a 13.5-ft roadway accomplish most of the mining. Factors considered in selecting this mining method included system efficiency, the effect upon the stability of the surrounding strata, and the aspect ratio of the opening. These machines avoid the fracturing around the mine opening caused by the drill-and-blast method. They also can easily provide an opening that has a favorable aspect ratio, good stability and space for a conventional roadway. Details of the mining system analysis and a more complete description of this equipment are contained in Addendum A.

A conventional drum-type mining machine (see Drawing 94572-M2) was selected on the basis of its adaptability and mobility for those job requirements that the continuous miner cannot accomplish; e.g., odd-shaped openings in the experimental area. The drum miner also serves as a backup for the boring machines.

4.5 MINE EMERGENCY ESCAPE SYSTEM

An underground mine, by Federal Regulation 57.11-50, "shall have two separate properly maintained escapeways to the surface which are so positioned that damage to one shall not lessen the effectiveness of the other, or a method of refuge shall be provided when only one opening to the surface is possible."

The WIPP conceptual design has five "openings to the surface"--the main shaft, two waste-handling shafts and two ventilation shafts. All are of sufficient size for effective personnel evacuation, and the first three are equipped with permanent hoist systems.

The man and material shaft is the main route for personnel access between the surface and underground. If this shaft is unavailable for use, the construction ventilation shaft will provide the required second access. This second access route was chosen because it connects to both mine levels, and because it is not radioactively contaminated.

The major components of the escapeway (headframe, hoist and mancage) are shown on Sheets A3 and A4 of Drawing 94572. The collar ventilation elbow, used to make a transition from the circular shaft to a rectangular shape for ventilation installation reasons, includes access doors for the emergency cage.

The construction ventilation shaft is equipped with shaft sets to support the cage guides. The shaft stations on both levels are fenced off to prevent access, but gates allow access to the cage in emergencies. Underground escapeways providing access to the shafts from the working places are numerous due to the multiple-entry design.

Although the TRU and RH shafts may become contaminated, they can, depending upon the nature of the emergency, provide alternate escape systems from their respective levels. Therefore, this conceptual design provides the two escapeways between underground and surface as required and, in most conceivable circumstances, also provides two additional alternates.

A mandatory regulation makes the operator responsible to develop specific escape and evacuation plans. These plans will be established first during the development phase and must be continuously updated because the number and arrangement of underground openings constantly changes.

4.6 SALT-HANDLING SYSTEMS

4.6.1 UNDERGROUND SALT HANDLING

The WIPP mining is done using mining machines. A pair of gathering arms, working on an apron below the cutting head of the mining machines, gathers the cuttings onto a flight-chain conveyor that propels the cuttings out the rear of the machine. A piggyback conveyor then moves the material into a feeder-breaker unit that in turn feeds onto the main conveying system to the man and material shaft (see Drawing 94572-M1). The piggyback conveyor allows the mining machine to make its one-step advancements across the width of an opening without movement of the main conveyor system or rehandling the salt after it is dumped on the floor by the mining machine. The main conveying system is advanced only prior to cutting the first pass in an opening.

Feeder-breakers that crush the salt to a maximum 6-in. size before it is placed on the conveyor belts permit use of smaller conveyor belts and reduce conveyor maintenance.

The maximum drive length on any underground belt conveyor is 2000 ft. When it is necessary for salt to be transferred from one belt to another, either as the result of a change of direction or because belt-drive length is exceeded, enclosed transfer chutes are used. On both levels, the construction exhaust air entry is also the main conveyor entry (see Drawing 94568-A6 and 94570-A6). On the TRU level, the salt from the mining operation is discharged by the main line conveyor into the TRU-RH muck raise, which also acts as a surge bin with a capacity of 738 tons. This raise is a nearly vertical 6-ft-diameter opening that is used to transfer the salt excavated on the TRU level down to the RH level. The main-line conveyor on the RH level discharges into a 750-ton surge bin.

Both the discharge conveyor for the TRU-RH muck raise and the RH level surge bin load onto a conveyor located in the salt transfer gallery (see Drawing 94571-A4). This conveyor then discharges into a 140-ton-capacity muck raise that loads into the loading pocket. The most efficient hoisting system is achieved by this handling procedure with a single-loading pocket. The separation of the salt from the two levels is provided by the surge bins. The surge capacity on each level is sufficient for approximately one and two-thirds continuous miner operating shifts.

4.6.2 SURFACE SALT HANDLING AND STORAGE

All the salt mined at the WIPP is stockpiled on the surface for the operating life of the facility. Alternatives for disposal of the salt not needed for backfilling are discussed in Addendum B. Drawings 94571-A6 and -A7 show the salt-pile configurations and conveyor systems used on the surface. The design assumptions for this system are:

a. Salt stored from each level (TRU and RH) must be maintained in separate piles.

b. The tops of the storage piles are at the same sea-level datum and no higher than 100 ft above the highest ground surface covered by the piles.

c. A water runoff containment dike is required to minimize salt migration.

d. A 37^{o} angle of repose is used for the salt.

e. The underground development as defined in this conceptual design produces approximately 2.3 million tons of TRU salt and 3 million tons of RH salt.

The salt, hoisted from underground, is dumped into a 250-ton surge bin at the headframe on the man-and-material shaft. An elevated and covered main conveyor moves the salt from the surge bin, over the road, railroad and security fence out to the storage area. This conveyor discharges into a 50-ton surge bin that loads two transfer conveyors running at right angles to the main conveyor.

The bin contains two hoppers, one serving each transfer conveyor. A remote-controlled flopgate controls the direction of salt flow to either the TRU or RH transfer conveyor. Each transfer conveyor discharges into a feeder bin that in turn feeds the skid conveyors that move the salt to the top of the stack and then along the top to a mobile radial stacker. The radial stacker places the salt onto the storage pile; it rotates over a 110^{o} arc at a 140-ft radius and is able to discharge over a 230-ft-wide area.

Standard-sized dump trucks may be loaded from the headframe surge bin simultaneously with conveyor handling of the salt, thus reducing the potential for operational shutdown as a result of surface conveyor system failure.

4.7 HEATING AND COOLING SYSTEM

Most WIPP heating and cooling systems are electrically powered. The general and specific aspects of the heating and cooling systems are described in Section 1.6 and Addendums D and F.

4.8 MOBILE SUPPORT EQUIPMENT

4.8.1 SURFACE MOBILE SUPPORT EQUIPMENT

A substantial amount of mobile support equipment is required at the surface to transport personnel, material and equipment. Automobiles and pickup trucks are provided to transport personnel and light loads. Forklifts with capacities ranging from 1500 to 40,000 lb load, unload, and transfer material. Four prime movers compatible with road and rail equipment are planned for on-site movement of trailers and railcars. Site emergency equipment includes a fire engine and an ambulance.

4.8.2 UNDERGROUND MOBILE SUPPORT EQUIPMENT

Underground mobile support equipment is shown in Drawing 94572-M2. Support vehicles for both construction and storage operations (except waste handling) are commercially available. No specially designed equipment is required, nor does any of the equipment require extensive modification. All equipment powered by combustion engines is diesel-powered and approved for underground use by the U. S. Bureau of Mines. Table II.4-8-2-1 shows the equipment provided and its function.

TABLE II.4-8-2-1

Underground Mobile Support Equipment

Equipment	Function
Two- and Five-Man Buggies	Transportation for supervisory, technical and service personnel
Twelve-Man Personnel Carriers	Transportation for work crews and/or groups of visitors
Utility Trucks	Hauling of repair parts and tools
Lowboy and Flatbed Trailers	Hauling of large equipment items
Lube Trucks	Work-site maintenance for large or less mobile equipment items
Road Grader	Haulageway maintenance
Fire Truck and Ambulance	Emergency services

4.9 TRANSPORTATION

4.9.1 RAIL

Railroad service to the WIPP site originates from a spur at the Duval Corporation mine. The proposed alignment consists of ~8 miles of new standard-gage railroad tracks using 110-lb rails. Drawing 94532-C1 shows the alignment from the Duval siding to the site boundary. The on-site railroad layout consists of a U-shaped arrangement with a minimum radius of curvature of 360 ft as shown in the WIPP Site Plan Drawing 94533-C1. The railroad system is standard gage with 110-lb rails, and all frogs are No. 8 or greater. The railroad layout provides for:

a. transfer from commercial locomotives to WIPP railcar movers on a siding between the gatehouse and Administration building,

b. a siding for access to the warehouse,

c. individual sidings for the TRU and RH Waste facilities and

d. sufficient on-site railcar parking space for 30 each 70-ft railcars.

4.9.2 ROADS

As shown in Drawing 94532-C1, access to the site is from U. S. 62-180. A typical section consists of two 12-ft driving lanes and two 8-ft shoulders as shown in Fig. II.4-9-2-1. Total length of the main access road is approximately 12 miles. On-site roads are arranged as shown in Drawing 94533-C1. The typical section is shown in Fig. II.4-9-2-2.

4.9.3 PARKING

On-site parking is provided for employee vehicles, site maintenance and staff vehicles as well as for waste transportation vehicles. Parking area for waste transportation vehicles is provided with special concrete pads to support the trailer stands when uncoupled from the tractors.

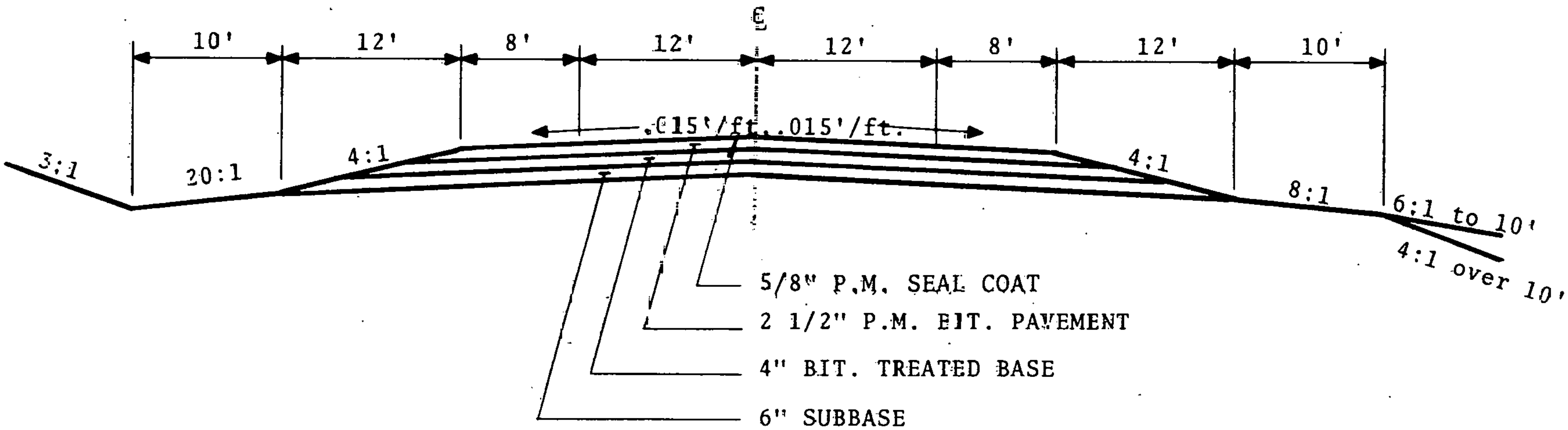

Figure II.4-9-2-1. Typical section for WIPP off-site roads

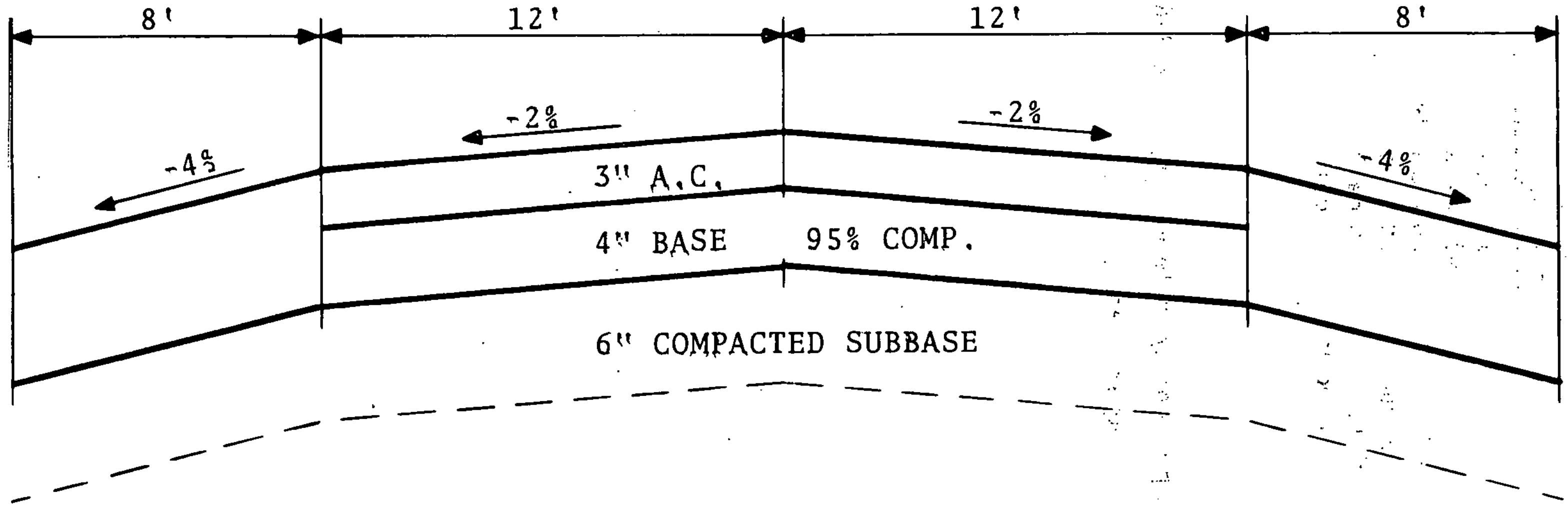

Figure II. 4-9-2-2. Typical section for WIPP on-site roads

Site parking capacities are:

	Vehicle Capacity
Site entrance gatehouse	10 cars
Area A employee parking	440 cars
Waste transport trailer park	20 trailers
TRU facility maintenance parking	10 cars
RH facility maintenance parking	6 cars
Facility vehicle maintenance parking	20 cars

4.9.4 WALKWAYS

Walkways are 4-in.-thick poured concrete varying from 3-8 ft in width as required to meet pedestrian traffic requirements.

4.10 WATER SYSTEMS

4.10.1 WATER TO SITE

The WIPP site does not have a local source of water. Water is furnished from the Double Eagle Water System owned by the City of Carlsbad and located in the Caprock area ~40 miles due north of ERDA No. 9. This distribution system extends 33 miles west (~7 miles from Artesia), and 19 miles south of the well fields. Transmission lines are of bare steel, cement asbestos or PVC. Most of the mains are steel pipe and are not looped.

The suggested tie-in point is ~28 miles north of ERDA No. 9 on the Eddy/Lea County line at an existing 10-in. main. Elevation is 3827 ft (elevation of the WIPP site is 3414 ft) with a minimum pressure of 100 psi and a maximum pressure of 290 psi. The proposed main runs due south from the tie-in point for ~15 miles to the Carlsbad/Hobbs Highway (U.S. 180) and continues along the WIPP site access road for another 13 miles, terminating at two 200,000-gal underground storage tanks on-site. Drawing 94532-C1 shows the proposed routing. Flow diagram 94535-C1 shows a representation of the system. The Double Eagle system has a 542-gpm reserve pumping capacity now and five new wells will be drilled. Storage capacity is one 126,000-gal reservoir by one well field, and a 210,000-gal reservoir by the other. If water is furnished by the existing booster pumping system, then only pressure-reducing stations are required. Three pressure-reducing stations are planned. The peak demand at the WIPP site is 332 gpm, with an average of 52 gpm. Water-demand calculations are included in Addendum A. Flow to the site is metered as the supply main crosses the site boundary.

4.10.2 ON-SITE WATER SYSTEMS

The total site population is estimated to be 349 people on the first shift and 26 and 15 people on the second and third shifts, respectively. The total fresh-water demand is based on:

a. Domestic consumption: 50 gal per capita daily

b. Fire Flows: 1500 gpm for 90 min with a residual pressure of 55 psi plus normal domestic demand and an 8-hr fire reserve recovery.

c. Industrial Service Consumption: 5,000 gal per day.

The total water storage requirement is therefore ~200,000 gal. Two underground concrete storage structures, each with a capacity of 200,000 gal, are provided, along with a looped distribution system. Each water storage structure is 54 ft in diameter and 14 ft high and constructed of concrete. Water from the Double Eagle System is not potable and is chlorinated at each pumphouse before storage and distribution. Chlorination is the only treatment required.

4.10.2.1 Domestic Water System--A duplex constant pressure pumping system able to pump 100 gpm @ 60 psi is provided at each storage tank. The system is looped between the two underground storage tanks and is separate from the fire protection system. Flow diagram 94535-C1 shows the design flow rates for each site building. Utility site plan, Drawing 94534-C1, shows the distribution network.

4.10.2.2 Fire Protection System--The surface fire protection system consists of two water storage/pumping stations connected by a system of underground water mains looping the aboveground facilities. Drawings 94535-C1 and 94534-C1 show the system flow diagram and site arrangement.

Each of the two storage/pumping stations consists of a 200,000-gal underground tank and an underground pumphouse. A 1500-gpm, 125-psi, UL- or FM-listed electric fire pump and a 1500-gpm at 125 psi UL- or FM-listed diesel fire pump provides suction under constant head from the tank. (The pumphouse floor is level with or below the bottom of the tank.) The motor controllers and associated equipment for the fire pumps are UL- or FM-listed for their intended use. The installation conforms to all mandatory and advisory provisions of NFPA No. 20, Standard for Installation of Centrifugal Fire Pumps. The piping layout in the pump station shall provide reliability of redundant pumps during maintenance and impairments. The electric-motor-driven fire pump is a vital electric load powered from either the normal or the emergency power source.

Fire pumps are arranged to start automatically upon operation of any sprinkler or fire hydrant. A jockey pump maintains pressure on the fire protection water mains. Fire pumps will start if a pressure drop corresponding to a flow of 25 gpm is detected.

The aboveground facilities are looped with an underground water main system, supplying only fire hydrants and sprinkler systems, capable of delivering 1500 gpm at a residual pressure of 55 psi at each building when fed through the loop in one direction only. The minimum size for the looped pipe is 10 in. The minimum size feeding fire hydrants and sprinklers from the looped mains is 6 in.

Post-Indicator Valves (PIVs) are provided on the looped mains to provide sectional control to minimize the impact of a single water-main break. Sectional PIVs are provided on each side of the fire pump connections to the loop and also at the sprinkler system connection for buildings with radioactive contamination potential. PIVs are provided at connections for sprinkler systems. Curb box valves are provided at connections for fire hydrants. The underground water system is installed in accordance with NFPA No. 24, Standard for Outside Protection.

The water source system provides an 8-hr recovery rate following a fire demand of 1500 gpm for 90 min.

4.11 RADIOACTIVE WASTE SYSTEM

The WIPP facility generates radioactively contaminated by-product wastes. For the conceptual design it was assumed that liquid wastes are collected and processed to produce a noncontaminated liquid and contaminated sludge; solid wastes are collected, compacted and packaged; and gaseous wastes are filtered through the HEPA system before release. No sludge or compacted waste is processed at WIPP but instead is shipped to a processing plant. In the future, a processing capability may be included at the WIPP if the system selected is economical for the small quantities that will be generated.

4.11.1 LIQUID RADIOACTIVE WASTE SYSTEM

The liquid radioactive waste system collects, processes and discharges all radioactive waste water either to the recycle water system for reuse in the plant or to the suspect water pond. A system piping diagram is shown on Drawing 94536-Ml, and a cross section through the suspect water pond is shown in Figure II.4-11-1-1.

4.11.1.1 System Description--Liquid waste is collected in tanks located in the RH, TRU, Suspect Waste/Laundry, and Mine Storage Filter buildings. Wastes from these collection points are pumped to the Suspect Waste/Laundry building and stored in either the miscellaneous waste tank or the detergent waste tank, depending on the nature of the waste. Underground waste is collected in portable tanks that are emptied into the liquid waste system through a connection at the Suspect Waste/Laundry building. Detergent wastes are normally processed by filtration and pumped to the suspect water pond for disposal of excess water by evaporation.

Under normal conditions, miscellaneous waste tank contents are processed by filtration and ion exchange, collected in the monitor tank for evaluation and pumped to the recycle water tank for reuse in the plant. The system allows reprocessing from one monitor tank through filtration and ion exchange to the other monitor tank if necessary.

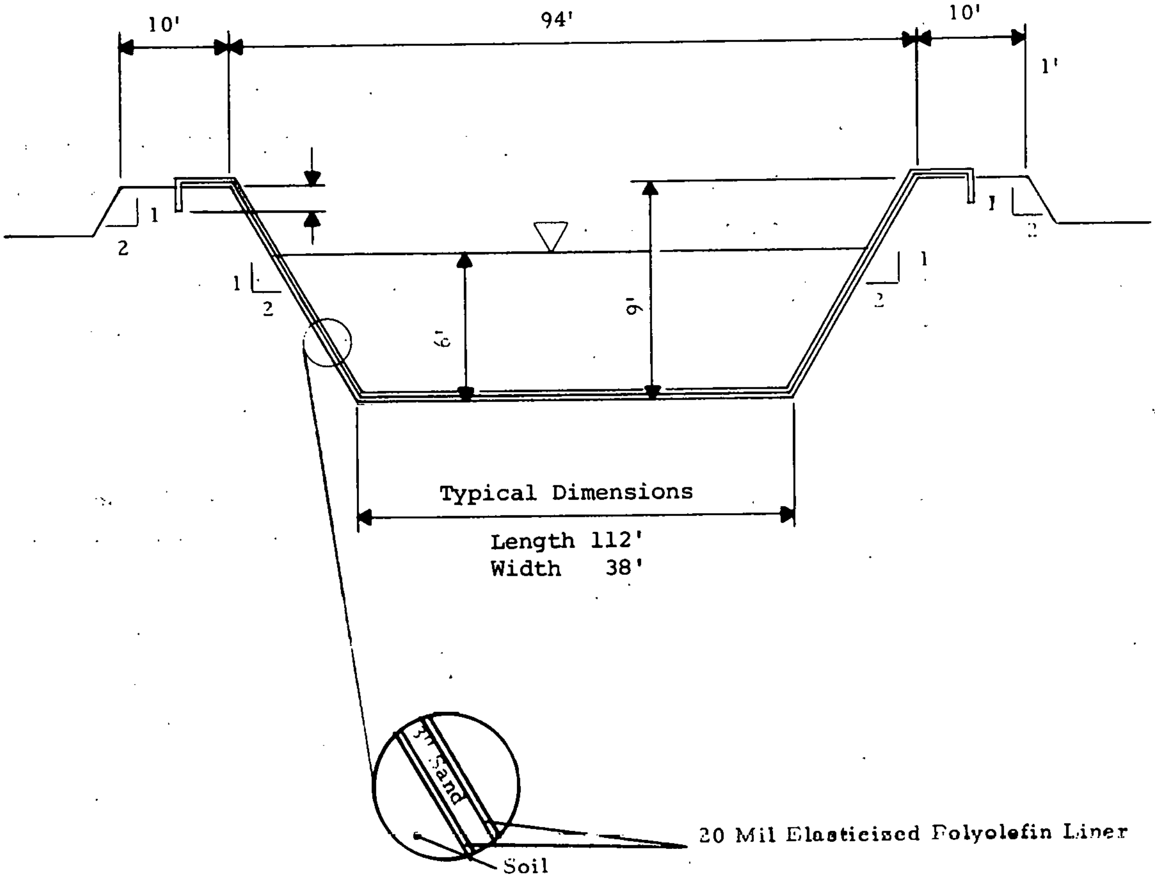

Figure II.4-11-1-1. Suspect waste pond

Process components accommodate the waste volumes postulated for normal plant operations, although adequate capacity exists to prevent the uncontrolled release of liquid waste to unrestricted areas under postulated accident conditions. The system is designed for parallel processing of miscellaneous and detergent wastes. Flexibility is incorporated into the design to maximize storage and processing flow paths for liquid waste in special situations. Process methods permit maximum reuse of water through the recycle water system that is described in Section 4.11.1.3.

Local and remote monitoring and control instrumentation are provided to allow monitoring of tank levels, starting and stopping of process pumps, monitoring of process ion exchange inlet temperature, and measuring process and area radiation levels. The remote monitoring and control station are in the Suspect Waste/Laundry building. Activity levels of water discharged from the monitor tanks to the suspect waste retention pond or the recycle water tank are continuously monitored and flow stopped or diverted in the event of higher-than-allowable radioactivity levels.

4.11.1.2 Sources of Liquid Waste--Radioactive liquid wastes are generated by daily operations and by intermittent decontamination activities. The system is sized on the assumption that areas where radioactive material is handled are decontaminated once a month. Volumes used in sizing the system are tabulated in Table II.4-11-1-1.

Remote Handling Facility. As shown in Table II.4-11-1-1 much of the liquid radwaste generated comes from operations in the Remote Handling facility.

Under normal conditions the most highly contaminated water is that drained from liquid cooled shipping casks. Cask cooling water is filtered during cask cooling and before being discharged to the RH building collection tank. Concentrations from cask decontamination operations are fairly low since the casks are decontaminated prior to shipment to WIPP. Canister cleaning accounts for a daily 50-gal input into the liquid radwaste system. Concentrations from this source are nearly as high as for shipping cask cooling operations.

Decontamination of the cask preparation and decontamination area generates about 1680 gal, while a postulated fire in this area results in significantly higher quantities. A hot-cell fire in conjunction with a canister drop could result in very high radioactive concentrations in the liquid waste.

TABLE II.4-11-1-1

Liquid Radioactive Volumes

Source	Normal Daily Liquid Radwaste (gal) Miscellaneous	Detergent	Normal Decon/Cleaning Liquid Radwaste (gal/month) Miscellaneous	Detergent
RH Building				
Cask Decontamination	400			
Lid Decontamination	200			
Cask Cooling Drain	820			
Contaminated Shower	50	50		
Hot Cell Decontamination			600	
Cask Service Area			1680	
Prefilter Cleaning			20	
Lab Samples	90	—	—	
Subtotal	1560	50	2300	
TRU Waste Facility				
Lab Samples	180			
Contaminated Shower		50		
Receiving Area Decon.			4200	
Inventory/Prep Decon.			4725	
Overpack/Repair Decon.			1500	
Prefilter Cleaning	—	—	20	
Subtotal	180	50	10445	
Suspect Waste/Laundry Building				
Laundry		865		
Contaminated Shower		50		
Area Decon.			875	
Prefilter/Equip. Decon.	—	—	20	
Subtotal		915	895	
Miscellaneous				
Mine Waste				1400
Railcar/Truck Wash.*	(1000)			
Mine Storage Filter Building			160	
Subtotal	1000		160	1400
Total	2740	1015	13800	1400

*planned future facility

TRU Waste Facility. Daily waste quantities from the TRU Waste facility are much less than those from the RH facility. All wastes, except from showers, are transferred to the miscellaneous waste tank for processing by filtration and ion exchange. Activity levels in this waste are very low.

The quantity of radioactive liquid waste generated during the design basis TRU Waste facility accident is about 16,000 gal. In case of accident, radioactive concentrations may be much higher than for normal operations.

Suspect Waste/Laundry Building. Waste water generated on a daily basis is due primarily to laundry operation. This waste is collected in the detergent waste tank for processing by filtration before discharge to the suspect waste pond.

Mine Waste. Waste is generated in the TRU and RH mine levels from showers and equipment decontamination. About 1400 gal of low radiological concentration, detergent-contaminated waste are produced each month.

Railcar/Truck Wash. A design value of 1000 gal/day has been established for this facility; however, since this water is normally nonradioactive, it is processed through the normal sewer system or pumped directly to the suspect waste pond without processing. If radioactivity levels are of concern, this waste can be processed through the miscellaneous waste tank or through the detergent waste tank to the miscellaneous waste tank.

Mine Storage Filter Building. Normal inputs to the liquid radwaste system are due to prefilter and miscellaneous equipment decontamination. As with the TRU and RH Waste facilities, concentrations of the liquid waste generated in this building as a result of an accident could be relatively high.

4.11.1.3 Equipment Description

Tanks. Process tanks in the liquid radwaste system are sized to contain the waste quantities shown in Table II.4-11-1-1 for the maximum normal day with a 20-percent contingency factor. Receiver tanks located in each of the buildings are sized to contain quantities generated by fire sprays. All liquid radwaste system tanks are of stainless steel.

Pumps. Collection tank pumps are sized to transfer normal tank inventories, including decontamination wastes, in 4 hrs. Process tank pumps are sized to transfer process liquids generated under normal conditions in 6 hrs. Expected tank, pump, filter and ion-exchanger design parameters are summarized in Table II.4-11-1-2.

4.11.1.4 Recycle Water System--The recycle water system consists of the recycle water tank, recycle water pumps, and piping necessary to supply water for reuse in the plant. The plant is designed to reuse the greatest amount of water possible. Domestic water is used if water from the recycle water system is not available. Recycle water is not used for personnel showers, washing railcars or trucks, in the laundry, in the laboratory, or in areas where radioactive contamination is not normally present.

The system receives water pumped from the radioactive liquid waste system to the 7500-gal recycle water tank. Water from the radioactive liquid waste system is monitored before and during release to the recycle water system to ensure that radioactivity levels are low enough to permit reuse. From the recycle water tank, water is supplied for reuse in the plant. Recycle water normal daily uses and the largest postulated decontamination are shown in Table II.4-11-1-3. Excess water is discharged to the Suspect Water Pond and evaporated.

Equipment Description. A flow diagram for the system is shown in Drawing 94540-P3.

Recycle Water Tank. This tank is sized for normal daily recycle water use, including the decontamination of the TRU inventory/preparation area, with a 20-percent contingency factor.

Recycle Water Pumps. Two pumps are provided, each rated at 20 gpm. This pump size permits completion of the largest area requiring decontamination in about 2 hrs with two pumps running, and transfer of the entire anticipated tank inventory in less than 6 hrs with only one pump running.

4.11.2 SOLID RADIOACTIVE WASTE SYSTEM

The solid waste system collects, compacts, and packages solid radioactive waste material generated on the WIPP site for shipment to off-site locations for processing and/or storage. Solid wastes consist of dry solids, to be compressed and drummed, and sludges produced from operation of the liquid radioactive waste system.

4.11.2.1 System Description--Dry solid wastes are collected at their source points and delivered to the TRU Waste facility overpack and repair area where the compactor and drum sealer are located. They are then packaged and inventoried for shipment off-site.

TABLE II.4-11-1-2

Equipment Design Parameters

Component	Tank Capacity (gal)	Pump Capacity (gal)	Filter/Ion Exchanger Type/Size-Rating
Miscellaneous Waste			
TRU Building	20,000	20 (2)	
RH Building	15,000	20 (2)	
Radwaste/Laundry Deck Drain	3,500	5	
Mine Storage Filter Drain	3,500	5	
Railcar/Truck Wash	1,000	15	
Detergent Waste			
Laundry/Radwaste	1,000	15	
TRU Contaminated Shower	400	5	
RH Contaminator Shower	300	5	
Mine Level Waste	350	5	
Process			
Detergent Waste	2,000	5 (2)	Cartridge 25μ
Miscellaneous Waste	8,000	20 (2)	Cartridge 1μ
Monitor Tank (2)	3,500	10 (2)	
Suspect Waste Pond	200,000	20	
Mixed Bed Ion Exchangers (2)			Mixed Bed 12 ft^3

TABLE II.4-11-1-3

Normal Daily Recycle Waste Use Including Largest Decontamination

Use	Volume (gal)
Shipping cask decontamination	400
Cask lid decontamination	200
Cask cooling system supply	820
Canister cleaning system makeup	50
TRU inventory/preparation decontamination	4725

Filter sludges and spent ion exchange resins are pumped directly from storage tanks into casks for shipment off-site. Instrumentation is used to monitor wastes shipped off-site to ensure compliance with appropriate regulations governing radioactive waste shipment.

4.11.2.2 Sources of Solid Wastes--Solid wastes are generated in the RH, TRU, Suspect Waste/Laundry and Mine Storage Filter buildings as well as in the underground storage areas due to normal maintenance, plant decontamination, cleanup, protective clothing discards, plant and process operations, and accidents.

Filter Replacement. The largest single source of solid waste resulting from normal maintenance activities is dirty ventilation filters. Under normal conditions and except for HEPA filters located in the hot cell, these filters are handled by direct contact with protective clothing and respirators to keep personnel exposure as low as possible. Filters are compacted and packaged prior to shipment off-site.

HEPA filters in the hot cell are removed using the normal hot cell remote-handling equipment, loaded in a shielded container through the cask unloading port and transferred to the solid radioactive waste storage area for off-site shipment. If radiation levels are low enough, these filters are sent to the waste compactor in the TRU Overpack and Repair facility for compaction and packaging prior to shipment.

Miscellaneous Activities. Equipment decontamination and maintenance, plant decontamination, and protective clothing discards generate waste rags, clothing, contaminated equipment parts, drum swipes, plastic bags and similar waste. An estimated compacted volume of 1500 ft^3/yr is generated from the sources described.

By-Products of Liquid Systems--Solid radioactive wastes in the form of filter cartridges, spent ion resins and sludge are generated by the liquid waste system, canister cleaning system and cask cooling system. Spent ion exchange resins are generated at the rate of about 12 ft^3/yr. They are flushed to the spent resin storage tank located in the Suspect Waste/Laundry building. Cartridge filters are used in processing of liquids from the detergent waste and miscellaneous waste tanks. Filter cartridges have low radiation levels and are handled by direct contact. The compacted filter cartridge waste volume is about 50 ft^3/yr.

Backflushable filters are used in the canister cleaning and cask cooling systems. Filter sludge is discharged to the filter backflush storage tank located in the Remote Handling facility. This sludge, which can be highly radioactive, is periodically flushed from the storage tank and shipped off-site. Excess liquids are decanted to the liquid radwaste system. The estimated volume of filter sludge waste is about 10 ft^3/yr.

4.11.3 GASEOUS RADIOACTIVE WASTE SYSTEM

The gaseous radioactive waste system collects, monitors and filters potentially contaminated gas streams from facility processes.

4.11.3.1 System Description--Potentially contaminated gas streams from RH Waste facility processes are gathered in a vacuum tank before release through exhaust filters. Gas streams from the liquid waste tanks in the Suspect Waste/ Laundry, TRU Waste and Mine Storage Filter buildings are discharged to the ventilation systems and monitored by the exhaust radiation monitors.

4.11.3.2 Sources of Gaseous Waste--Radioactive gas streams may be emitted from the RH Waste, TRU Waste, Mine Storage Filter and Suspect Waste/ Laundry buildings. The primary source is coolant gas vented from dry shipping casks. Other sources are:

- Overpack canister welding vent gas
- Cask cooling system noncondensables
- Liquid radwaste processing and collection tank vents
- Canister overpack leak tests

4.11.3.3 Equipment Description--Vacuum is maintained in a tank in the RH Waste facility by a vacuum pump. A standby vacuum pump starts automatically if the vacuum tank pressure rises above the set pressure range. The gas stream discharged from the vacuum pumps is analyzed for radioactivity as it passes to the RH building ventilation exhaust filters. Release to the ventilation system is automatically stopped if high radiation levels are detected. A flow diagram for the system is shown in Drawing 94540-P3.

4.12 STORM SEWER AND NONRADIOACTIVE WASTE SYSTEM

4.12.1 SANITARY SEWERS

The site sanitary sewer system meets state and EPA regulations where appropriate. Sewage collection is by gravity flow throughout the site, terminating at a sewage lift station equipped with float-controlled, duplex 100-gpm pumps to pump the sewage to the on-site treatment plant. Drawing 94534-C1 shows the system layout, and 94535-C1 the flow diagram for the system design. Treated effluent is discharged into a holding pond that has at least 7 days' storage capacity. Most processed effluent is recycled for landscaping irrigation. Pumps are provided to irrigate selected areas. Based on a design effluent discharge rate of 100 gal per capita per day, a peak flow of 35,000 gal per day is generated during the first shift. No appreciable effluent is generated during second and third shifts; however, the sewage system is adequate if three full shifts are in operation.

4.12.2 STORM SEWERS

The site is protected from storm runoff by two means. First, an interceptor ditch and berm diverts runoff from the drainage plane above the site around the site perimeter. Where the water passes under the site entrance road and railroad, a box culvert is provided. The overall site plan, Drawing 94533-C1, shows the location of the interceptor ditch and box culvert. Figures II.4-12-2-1 and II.4-12-2-2 show the cross sections of the ditch and box culvert, respectively.

The second means of runoff control is the on-site collection system. Drawing 94534-C1 shows the buried storm sewer system piping. The system collects runoff from paved areas and the buildings, and directs it to the low side of the site for release to a drainage channel. Buried storm sewer piping is reinforced concrete above 15-in. diameter and nonreinforced concrete below 15-in. diameter.

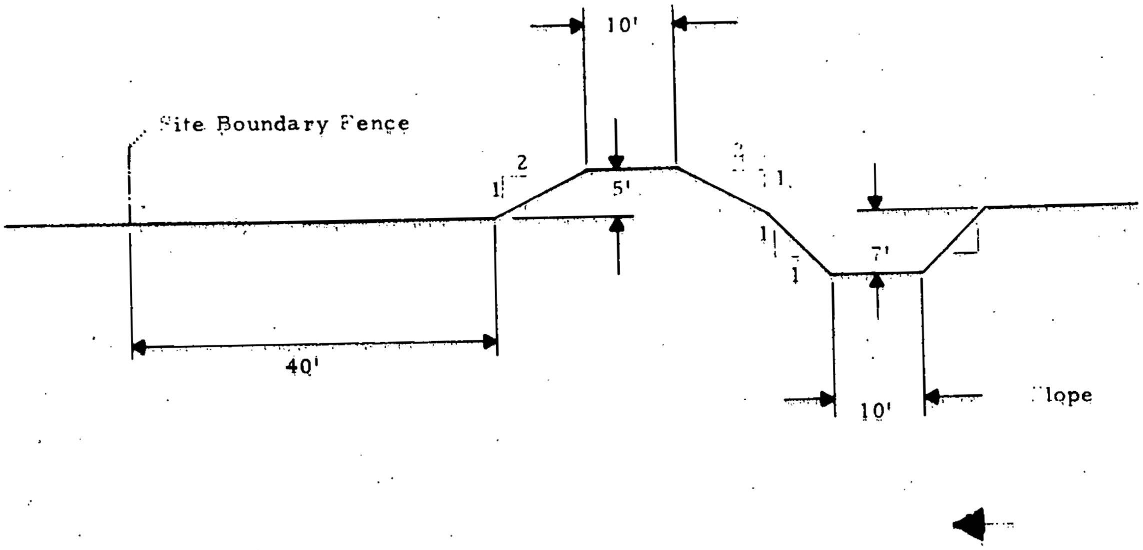

Figure II.4-12-2-1. Intercepter ditch and berm

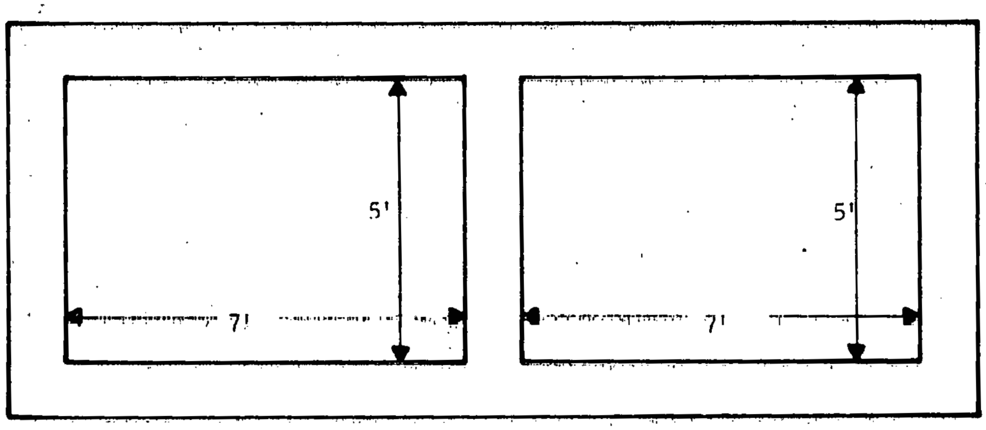

Figure II.4-12-2-2. Box culvert intercepter

4.13 FIRE PROTECTION SYSTEMS

4.13.1 SURFACE FACILITIES

4.13.1.1 General Provisions--All buildings with the exception of the Site Entrance Gatehouse and the Emergency Power building are provided with a complete wet-pipe sprinkler system designed in strict accordance with NFPA Pamphlet No. 13. Ordinary hazard pipe schedule systems are provided in normal use areas while extra hazard systems are provided in areas where significant quantities of flammable liquids or other occupancies of heavy fuel loading exist. The sprinkler systems in Category I and II facilities are designed to include the protection of piping from earthquake loadings. Pendant-type sprinkler heads arranged in a modular pattern are provided below suspended ceilings with piping located above the ceilings. Upright-type sprinkler heads are provided in all other areas except in spaces above ceilings where no combustible materials exist. Sprinkler heads in Category I and II facilities are of the thermostatically controlled type (U. L. on-off type), with temperature ratings appropriate to the area hazard.

Sprinkler heads in Category III facilities are regular closed-type heads with a 165°F temperature rating for normal occupancy areas, a 212°F rating in the computer and control rooms, and a higher rating per the NFPA when utilized near heat sources. A U. L.-approved sprinkler alarm check valve with water motor alarm gong, pressure switch, and F. D. Siamese connection is provided at each building. Post-indicator valves are also provided on the fire mains outside the buildings, with Category I building indicator valves protected from tornado-induced missiles.

Firehose cabinets and wall-mounted fire extinguishers are provided in all facilities and installed in accordance with applicable codes and standards. The sprinkler systems, Halon systems, manual fire-alarm boxes, and other fire-alarm devices are connected to the building and site fire-alarm systems.

4.13.1.2 Special Provisions--The electronic equipment in the operations control portion of the Administration building is protected by Halon systems in addition to the wet-pipe sprinkler system The exhaust hood in the food preparation area of the cafeteria is protected by an automatic dry-chemical fire-extinguishing system that when actuated will shut off electricity to the heating devices in the protected areas.

The Emergency Power building is protected with a low-pressure $C0_2$ total flooding system in the generator rooms and within the feeder breaker enclosures. The system is actuated by a combination of rate of rise and fixed temperature sensors. Mechanical/pneumatic time delay valves and $C0_2$ gas-operated sirens are provided to permit safe evaluation prior to $C0_2$ discharge. The system also provides a capability for immediate second gas release.

4.13.2 UNDERGROUND FACILITIES

Underground fire protection is primarily provided by two fire trucks, one at each level. These units have foam generation equipment and chemicals for fire fighting. The following facilities are enclosed in fire-resistant structures and protected with automatic fixed fire protection systems such as $C0_2$, Halon, dry chemical, or foam: 1) computer room, 2) repair shop, 3) warehouse, 4) fuel and lubricant storage, 5) radsafe check area, 6) decontamination area, and 7) electrical substation.

Smoke and heat detectors are located throughout the mine and are zoned and connected to the fire alarm system. Fire doors and ventilation controls necessary to contain a fire or to control smoke are operable from the central monitor control rooms in the Administration building.

The following areas of concern will be addressed and evaluated in greater detail during Titles I and II: Establishment of Design Basis Fires (DBF) based on inventories of combustible loading; a study of automatic fixed fire suppression systems versus manual fire fighting in the support areas; arrangement of HEPA filtration to protect against plugging or rupture under fire conditions; the enclosure of hazardous areas; zoning of fire detection devices within the mine.

4.14 BUILDING MATERIALS

4.14.1 EXTERIOR

Walls:

- Category I buildings: poured-in-place concrete
- Administration, man and materials, man and materials hoisthouse, warehouse/shops, and vehicle maintenance buildings: prefabricated metal panels with fiberglass insulation on the interior side faced with 5/8-in. gypsum board.
- Site entrance gatehouse: stucco over C.M.U. with rigid insulation on interior side and furred 5/8-in. gypsum board.

Roof:

- Category I buildings: poured-in-place concrete with built-up roof over rigid insulation.
- Administration building: built-up roof over rigid insulation board over lightweight concrete on metal decking.
- Site entrance gatehouse: built-up roof over rigid insulation board on metal decking.
- Man and materials, warehouse/shops, vehicle maintenance, and man and materials hoisthouse buildings: metal roof (prefabricated metal buildings).

Tornado Doors:

- RH building: single heavy structural-steel-framed, horizontal sliding doors at entrance to cask transfer gallery.
- TRU, mine storage filter, suspect waste/laundry, and emergency power buildings: two single structural steel vertical leaf doors, each hinge-mounted to the walls. Each leaf is anchored at its free edge to the roof and to the base slab with a manually operated vertical sliding head bolt-foot bolt mechanism. The door construction consists of a pair of steel plates covering a structural steel frame.
- Entrance doors: aluminum entrance units at the main entrances with 1/4-in. tempered clear glass.

• Service doors: hollow metal in hollow metal frames.

• Rollup doors: metal slat doors, motor-operated.

Windows: 1-in. insulating glass (1/4-in. clear, 1/2-in. air space, 1/4-in. clear) fixed-in-aluminum frames. Outer layer is reflective.

4.14.2 INTERIOR

Walls and partitions: depending on the building construction and required fire ratings, major partitions will normally be either concrete masonry with furred gypsum-board finish on office side and exposed block in other locations, or 5/8-in. gypsum board over metal studs. Concrete interior walls will be used as necessary for shielding or structural integrity in Category I buildings. The Administration building will have movable partitions used for a 4' x 6' modular layout.

All showers and the toilet rooms in the RH, TRU, Man and Materials, and Administration buildings will have glazed tile walls.

Doors: hollow metal insulated in pressed-metal frames.

Floors: vinyl asbestos tile (1/8-in.) in all administrative office areas, and the gatehouse.

• Terrazzo at Administration building vestibule and lobby area.

• Raised floor system in computer and control rooms in Administration building, operations and control area.

• Ceramic tile in all shower rooms and in the toilet rooms of the RH, TRU, Man and Materials, and Administration buildings.

• Exposed concrete with non-dusting hardener in all other areas where special decontaminable coatings are not specified.

Base:

• 4-in. vinyl base where vinyl tile is used.

• glazed tile where ceramic tile is used.

Ceilings:

- lath and plaster over showers.
- gypsum board in toilet areas, janitor rooms, and locker rooms.
- 2' x 2' lay-in mineral fiber acoustical panels in exposed "T" grid system for administrative offices, lobbies, and hallways.
- exposed construction in all other areas.

Special Coatings: all waste-handling areas in the RH and TRU buildings will have walls, floors, and ceilings coated with a decontaminable coating such as Carboline's Phenoline 305 or equal. All interior surfaces in the Suspect Waste/Laundry and Mine Storage Filter buildings that may be contaminated during operation will also be coated with Carboline's Phenoline 305 or equal.

Miscellaneous:

- Toilet partitions: metal, baked-enamel finish, floor mounted.
- Toilet accessories: standard stainless-steel units.
- Hand rails: steel pipe, painted.

5. ADDENDA

A. Design Calculations for Waste Isolation Pilot Plant (WIPP) Conceptual Design Report, Edited by Nuclear Waste Engineering Division 1142

B. Tailings Disposal Proposal By David L. Poli, Nuclear Waste Engineering Division, Sandia Laboratories, Albuquerque, New Mexico, March 9, 1977

C. Cost Worksheets for Waste Isolation Pilot Plant (WIPP) Conceptual Design Report, Edited By Nuclear Waste Engineering Division 1142

D. A Report to Holmes & Narver, Inc., Anaheim, California, on Alternative Energy Sources for Waste Isolation Pilot Plant, Carlsbad, New Mexico. Prepared By Envirodyne Energy Services, Anaheim, California (A647)

E. Electrical Load Summary for Waste Isolation Pilot Plant (WIPP) Conceptual Design Report, By Holmes & Narver, Inc., Anaheim, California, April 1977

F. HVAC Systems Energy Analysis for Waste Isolation Pilot Plant (WIPP) Conceptual Design Report, By Holmes & Narver, Inc., Anaheim, California, April 1977

G. Accident Analysis for Waste Isolation Pilot Plant (WIPP) Conceptual Design Report, By Henry C. Shefelbine, Nuclear Waste Engineering Division 1142, and James H. Metcalf, Instrumentation, Dosimetry and NTS Projects Division 3313, Sandia Laboratories, Albuquerque, New Mexico

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, March 9, 1977

I. Soils and Foundation Investigation for Proposed Waste Isolation Pilot Plant, Eddy County, New Mexico, By Richard R. Pettigrew and Associates, Consulting Engineers

J. Conceptual Design Report of Support Equipment in the High Level Waste Facility of the Waste Isolation Pilot Plant, By Aerojet Manufacturing Company, Fullerton, California (AMCO 1948-76-01)

K. NRC Regulatory Guide Review for Waste Isolation Pilot Plant (WIPP) Conceptual Design Report, Edited By Nuclear Waste Engineering Division 1142, Sandia Laboratories, Albuquerque, New Mexico

L. Mine Safety Code Review for Waste Isolation Pilot Plant (WIPP) Conceptual Design Report

M. Computer System and Data Processing Requirements for Waste Isolation Pilot Plant (WIPP) Conceptual Design Report, By Richard Young, Nuclear Waste Engineering Division 1142, Sandia Laboratories, Albuquerque, New Mexico, June 1977

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